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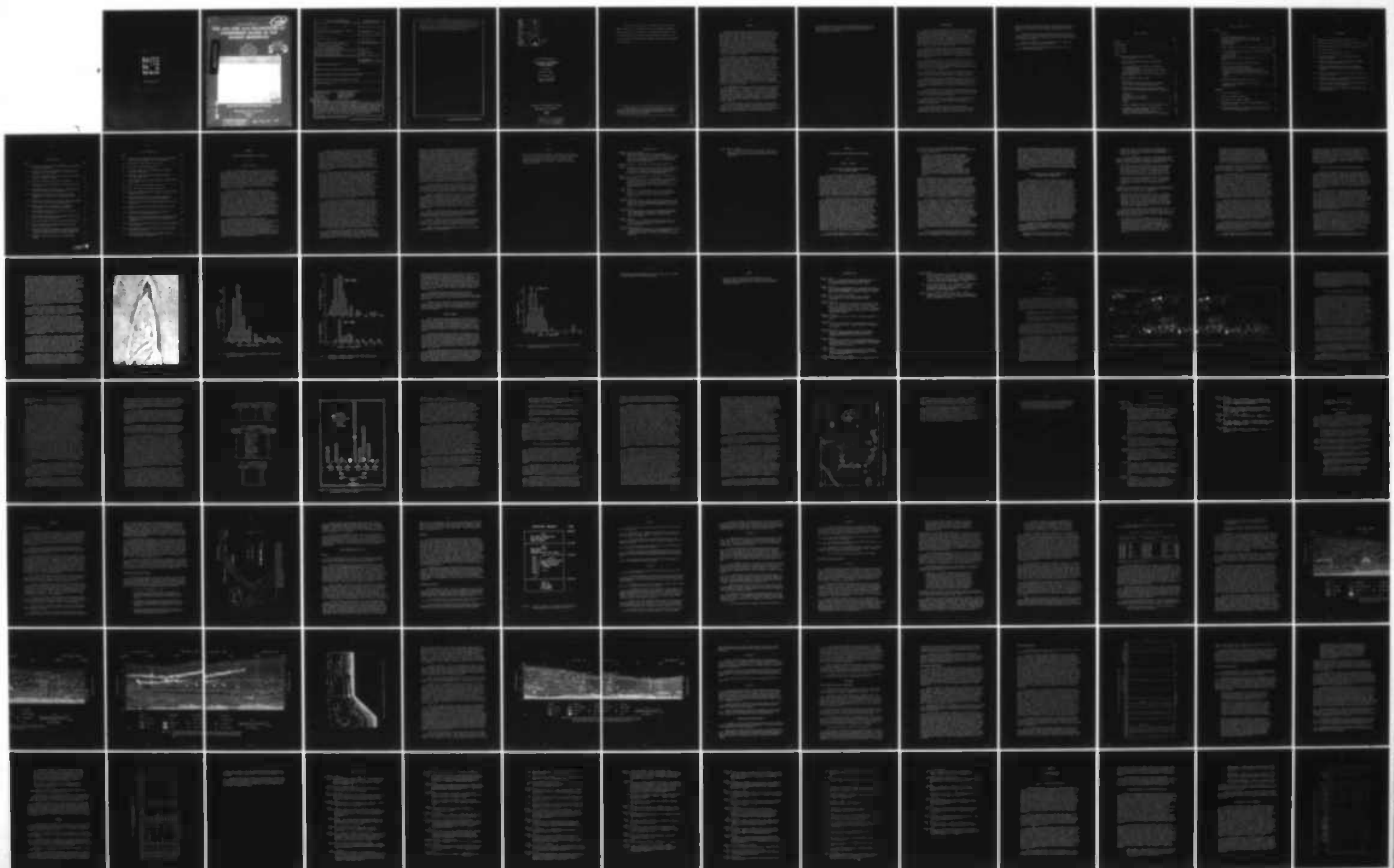

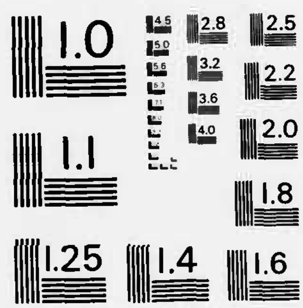

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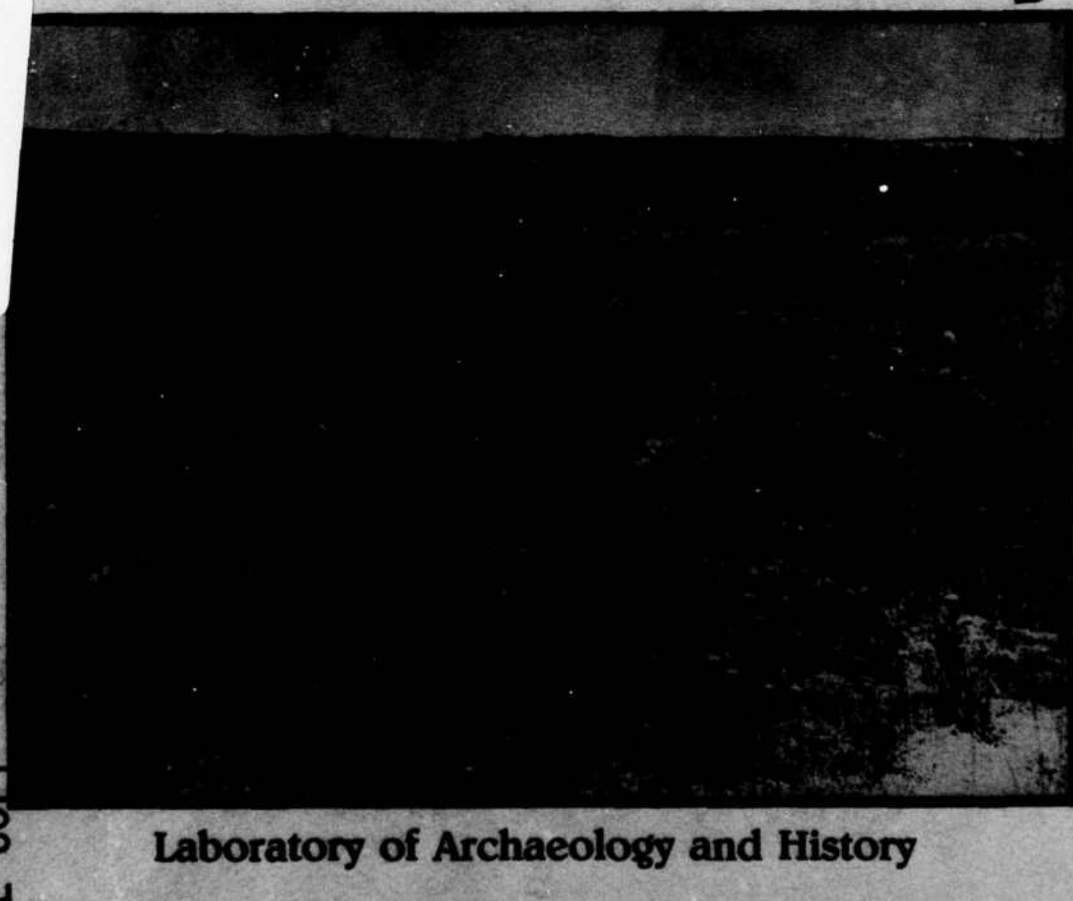
Project Report Number 19

THE 1978 AND 1979 EXCAVATIONS AT STRAWBERRY ISLAND IN THE McNARY RESERVOIR

edited by
Randall F. Schalk
with contributions by
Robert R. Mierendorf
Deborah L. Olson



Laboratory of Archaeology and History

Washington State University
Pullman
1983

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) The 1978 and 1979 Excavations at Strawberry Island in the McNary Reservoir		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Randall F. Schalk et. al.		8. CONTRACT OR GRANT NUMBER(s) DACW68-77-C-0101
9. PERFORMING ORGANIZATION NAME AND ADDRESS Laboratory of Archaeology and History, Washington State University, Pullman, Washington 99164-1352		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Corps of Engineers, Walla Walla District, Bldg 602, City-County Airport, Walla Walla, Washington 99362		12. REPORT DATE 1983
		13. NUMBER OF PAGES 229
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Approved for public release; distribution unlimited

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Strawberry Island, Miller Site, McNary Reservoir, prehistoric, housepit village, occupation intervals, housepit variability, subsistence pattern, adaptive shift

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A major objective in the Strawberry Island project was to evaluate the site with a focus on determining the significance of spatial distributional patterns and size variations in housepits. Intrasite assemblage comparisons and the analysis of relationships between surface features and their associated stratigraphy, fauna remains and lithics were carried out to asses the utility of the conventional view of late Plateau prehistory in which all temporal variation in the archaeological record has been considered superficial in character.

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20. It is proposed that an interval of increased aridity between 1,000 B.P. and 500 B.P. in combination with sufficient population levels resulted in an adaptive shift that is reflected in the archaeological deposits at Strawberry Island. It is further proposed that this shift involved subsistence adjustments including increased reliance upon fishing and settlement adjustments in the direction greater sedentism.

Project Report Number 19

THE 1978 AND 1979 EXCAVATIONS AT STRAWBERRY ISLAND IN THE McNARY RESERVOIR

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The 1978 and 1979 excavations at Strawberry Island in the Upper McNary Reservoir were undertaken for the U.S. Army Corps of Engineers, Walla Walla District, in fulfillment of contract number DACW68-77-C-0101. All contract information is filed at the Laboratory of Archaeology and History, Washington State University, Pullman, under codings 11F-3903-0082 and 11F-3903-0106.

Project Reports is a selected series disclosing the results of research in the form of final or interim reports submitted to agencies which have contracted with the Laboratory of Archaeology and History for information on cultural resources.

ABSTRACT

This report presents results of archaeological testing carried out at Strawberry Island Village (45FR5) in 1978 and 1979 by Washington State University under contract with the Walla Walla District of the Army Corps of Engineers. Post-impoundment impacts of McNary Reservoir have resulted in ongoing and measureable erosion of this very large, late prehistoric, housepit site. A major objective of this testing project was to evaluate the site with a focus on determining the significance of spatial distributional patterns and size variations in surface features ("housepits"). Intrasite assemblage comparisons and the analysis of relationships between surface features and their associated stratigraphy, fauna remains and lithics were carried out to assess the utility of the conventional view of late Plateau prehistory in which all temporal variation in the archaeological record has been considered superficial in character.

When combined with results of stratigraphic analyses, intrasite comparative analysis of the faunal assemblages lead to the interpretation that there were two major intervals of occupation at the site between 1,400 B.P. and Euro-American contact; these two occupation intervals were probably separated by several centuries. Associated with these two occupation intervals are distinctive architectural forms, faunal signatures, and lithic tool and debris frequencies. Although rabbit, pronghorn, and salmonid remains constitute the vast majority of economic faunal remains recovered from all areas of the site, the earlier occupation interval (steep-walled housepits) is characterized by faunal assemblages dominated by salmonid and the later occupation interval (saucer-floored houses) is characterized by rabbit or pronghorn dominated assemblages. Compared to the steep-walled structures of the earlier occupation, the later saucer-floored structures seem to be generally larger, more widely spaced, and less clustered in their arrangement. The floors of the later structural form also tend to have higher densities of debris associated with them.

The archaeological variability identified seems to be inconsistent with the static model of late prehistory in the Plateau and, therefore, requires explanation. It is proposed that an interval of increased aridity between 1,000 B.P. and 600 B.P. in combination with sufficient population levels resulted in an adaptive shift that is reflected in the archaeological deposits at Strawberry Island. It is further proposed that this shift involved subsistence adjustments including increased reliance upon fishing and settlement adjustments in the direction of greater sedentism.

The site has substantial cultural, scientific, and educational value to the public and this value has been recognized by the placement of the site on the National Register of Historic Places. Impacts occurring on the site presently include erosion and slumping, vegetation changes, relic collector impacts, and recreational user impacts.

It is recommended that bank erosion be controlled by installation of a rock-filled berm, that an effort be made to enforce the laws protecting cultural resources, that camping on the island be prohibited, and that vegetation be controlled.

ACKNOWLEDGMENTS

Summer time working conditions in the Pasco Basin are frequently far from pleasant and we are especially grateful to the many people who participated in the 1978-1979 seasons of work at Strawberry Island. The 1978 field crew included Gene Carlson, Terry Eller (crew chief), Timothy Gross (field director), Jennifer Jones-Brooks, Robert Mierendorf (geoarchaeologist), Deborah Olson (laboratory director), Nick Paglieri, Tim Pratt, Tim Seaman (crew chief), Kim Simmons, Kathy White (cook and camp manager), and Glen Yallup. In addition, there were seven field school students in 1978: John Douglas, Joy Foust, Annette Hoch, Johnny Long, Keith Mason, Anna Rago, and Dawn Shirley.

The 1979 field crew included Eileen Adams-Rasmussen, Audrey Allbee, Andy Barsotti, Rueben Burquez, Judy Giniger (crew chief), Timothy Gross (field director), Annette Hoch, Lyle Hubbard, Denise Leary, David Miller, Jim O'Hara, Deborah Olson (laboratory director), Nick Paglieri, Kim Simmons, Kathy White (cook and camp manager), and Robert Wilkinson.

Nick Paglieri worked as a volunteer throughout the entire project and his enthusiasm for archaeology was contagious. Nick gave generously of his time, donated personal equipment to the project, and was a key figure in its success. Murrel Comfort also worked as a volunteer on the project and on a number of occasions provided delicious garden produce for the field kitchen.

Individuals who worked at cataloging, labelling, storing, and related activities in the laboratory in Pullman included Kathy White, Betsy Tipps, Andrew Barsotti, Rueben Burquez, and Robert Wilkinson.

Ken Ames, David Chance, Gregory Cleveland, Alan Marshall, David Rice and Alston Thoms have all been willing discussants of subjects relating to Plateau archaeology. Greg Cleveland deserves special thanks for sharing his insights about late prehistoric adaptations in the region and for providing necessary continuity with the earlier work at the site.

Richard Daugherty was instrumental in securing funding for the project and was principal investigator through 1978. LeRoy Allen served as the contracting officer's representative for the Walla Walla District of the United States Army Corps of Engineers.

For a sincere interest in archaeology and a general breadth of knowledge that Colonel H. J. Thayer brought to his position as commanding officer of the Walla Walla District of the Corps, he must be recognized as exceptional.

Secretarial contributions to this project in terms of administrative duties, report typing, and many other activities were substantial. Cathy Eshleman typed a first draft of this report and managed budgets and the flow of paper for nearly two years. Lorna

Elliott and Dolores Lehn carried the report typing through the final draft stage. Gail Rowland, Phyllis Daugherty, Louise McGuff, and Dretha Beasley all assisted with clerical matters in the early part of the project.

Roderick Sprague graciously provided black and white prints of Strawberry Island that were taken during River Basin Survey work in 1951 and which now are curated in the Archives of Pacific Northwest Archaeology at the University of Idaho.

Nearly all the drafting of illustrations for this report was accomplished by Chuan-Kun Ho, except for Chapter 4.

Though not often a visible participant in this project, Gail Schalk's investment was substantial.

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CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE PROJECT

by

Randall F. Schalk

Since the 1975 archaeological survey in which the Strawberry Island Village was first observed to be suffering the effects of bank erosion (Cleveland et al. 1976), there have been four seasons of archaeological fieldwork conducted at the site.[1] This work, done by Washington State University under contract with the Walla Walla District of the Army Corps of Engineers, has had as its purpose the testing of this very large, late prehistoric village site. Objectives, procedures, and results of fieldwork carried out in 1977 and 1978 have been discussed in the previous annual reports (Cleveland et al. 1977; Cleveland 1978). This report is a discussion of the 1978 and 1979 archaeological investigations.

Harvey Rice and Richard Daugherty served as Principal Investigators in 1976 and 1977 respectively, and Gregory Cleveland served as Project Director during that interval. Cleveland was unable to continue as Project Director during the 1978 season and Randall Schalk was hired in that capacity in May of 1978. Project continuity was maintained as Cleveland continued to provide invaluable consultation and advice in the subsequent seasons of fieldwork. Schalk served as Project Director throughout the 1978 and 1979 seasons and also as Principal Investigator for the last year of the project. During the 1976-1977 seasons of fieldwork directed by Cleveland, efforts were aimed at site mapping and excavation of housepit features eroding along the shoreline of the site. During the third and fourth seasons, the emphasis was shifted towards testing the site as a whole and exploring the relationships between surface features, subsurface stratigraphy, and faunal and lithic assemblages. This approach promised to place the earlier housepit excavations into a larger context.

According to contractual requirements (Contracts DACW68-76-M-5055, DACW68-76-C-0097, and DACW68-77-C-0101), each season's work was to be reported in a yearly report. This procedure was necessitated by the funding which was made available on a year-to-year basis. Due to uncertainties in the availability of funding over intervals greater than a year, each year was treated as a self-contained effort. After the completion of the 1979 field investigation, additional funding for a thorough analysis and comprehensive reporting of data collected during the four seasons of investigations on the site was sought by Washington State University personnel, but the Corps was unable to provide funding for that purpose.

Prior to completion of the annual reports for 1978 and 1979, WSU was called upon to undertake two other urgent construction-related projects for the Walla Walla District of the Corps. One of these projects was the archaeological survey and testing at Umatilla, Oregon, for the second powerhouse at McNary Dam (Schalk 1980). The other project involved the survey and testing for a large fish hatchery near the mouth of the Palouse River at Lyons Ferry, Washington (Schalk 1983). In addition to these two projects, there were several other small surveys carried out for the Walla Walla District along the Lower Snake and Middle Columbia. These numerous other obligations resulted in delaying the completion of reporting responsibilities for the Strawberry Island project.

In the face of these circumstances, this report was assembled to combine the reporting of the 1978 and 1979 work under a single cover. While this report can by no means be considered a comprehensive statement, it does represent a closer approximation than would have resulted with two annual reports. It must be emphasized that the data recovered during the four seasons of work at Strawberry Island has analytical potential far surpassing the use to which it has been put in this report and we can only hope that some of this potential can be exploited more fully in the next few years. Two master's theses (Mierendorf 1981; Olson 1983) have been written on information recovered during this project and faunal data from the site has already proven useful for comparative and evaluative purposes in other cultural resource projects on the Lower Snake (Schalk 1983). A more general study of late prehistoric culture in the Middle Columbia/Lower Snake regions is already in progress and Strawberry Island will, no doubt, provide a critical data base for that study.

At the time the field investigations were being carried out, raising the McNary pool was being considered by the Corps as a means of increasing hydroelectric power production at McNary Dam. This raise in pool level would have resulted in the inundation and/or accelerated erosion of Strawberry Island. During the first three seasons of work at the site, future adverse impacts to the site from a pool raise were considered a very real possibility. It was, however, decided in late 1978 or early 1979 that a pool raise was economically unacceptable and that power generation could be augmented at McNary Dam without a pool raise. Even after plans for a pool raise were dropped, the crucial problem of ongoing erosion remained and it was unclear whether the site could be stabilized and protected. In particular, the Corps was uncertain whether bank stabilization in the form of rip-rap or other techniques was a feasible means of preserving the site. Because the island is maintained as a wildlife and goose-nesting habitat, preservation measures for the cultural resources presented trade-offs in terms of managing other resources and in terms of cost factors.

In simple terms, these circumstances raised a fundamental question for archaeological management. This question has to do with the extent to which this sizable site contains redundant and repetitive information and, therefore, the extent to which it warrants protection and/or preservation. If it were true, for example, that "when you have

seen one (or a few) housepits, you have seen them all," then it would be difficult to argue the necessity or economic wisdom of preserving the whole site--especially after partial excavation had been completed. Assuming that scientific questions of importance in archaeology could be adequately answered through excavation of a small portion of the site, it would be hard to justify the costs potentially associated with preserving the site. For these reasons, it seemed particularly apparent to us that evaluating the significance of this site depended upon an understanding of the degree to which it was internally differentiated. While a concern for questions pertaining to intrasite variability in large housepit sites has long been expressed in Plateau archaeology (cf. Osborne 1957), minimal progress has been made over the decades in dealing with the problem. Indeed, Osborne's work at 45BN53 in the 1950s still represents the most sophisticated attempt to address the subject of intrasite variability and spatial organization in large housepit sites on the Plateau; it was his belief that this subject was one of considerable importance for future archaeology in the Columbia Plateau (1957:10). As will be discussed in much greater detail in the next chapter, intrasite variability and community plan seem to be two topics of special relevance to a site like the one under investigation.

The following chapters proceed with a discussion of the general research orientation (Chapter 2) and excavation strategy (Chapter 3). During the 1978 season of fieldwork, substantial attention was devoted to the question of the site's depositional history and stratigraphy. This work, carried out by Robert Mierendorf, is discussed in Chapter 4.

Chapter 5, by Randall Schalk and Deborah Olson, is a discussion of the faunal assemblages from the site. Olson was single-handedly responsible for virtually all faunal identifications of the 1978 and 1979 collections. In addition, she re-examined a portion of the materials collected during the 1976 and 1977 seasons of work. The faunal data that was generated in this effort served as the basis for Chapter 5 as well as for Olson's (1983) M.A. thesis. The data manipulations and most of the rest of Chapter 5 are the work of the senior author.

Chapter 6 of this report deals with the lithic collections and amounts to a preliminary discussion employing the data resulting from laboratory identifications carried out by Jeffrey Flenniken (1978 collections) and Robert Wilkinson (1979 collections).

Chapter 7 summarizes the results of the 1978 and 1979 portions of the project, proposes a model of settlement/subsistence change during the past 1,500 years and discusses the implications of both for the nature of late prehistoric cultural change on the Lower Snake River.

Chapter 8 discusses impacts occurring to the site and provides recommendations for future management.

NOTES

1. This site was originally referred to as Strawberry Island Village when it was first reported by Drucker (1948) during the Smithsonian River Basin survey work in the late 1940s. In 1977, Richard Daugherty renamed the site in honor of a congressional aid to Senator Henry Jackson--Mr. Denny Miller. Since that time, both names have been used.

REFERENCES CITED

Cleveland, Gregory C. (editor)

1978 Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington. Washington Archaeological Research Center, Washington State University, Project Report No. 72.

Cleveland, Gregory C., Bruce Cochran, Judith Giniger, and Hallett Hammett

1976 Archaeological Reconnaissance on the Mid-Columbia and Lower Snake River Reservoirs for the Walla Walla District Army Corps of Engineers. Washington Archaeological Research Center, Washington State University, Project Reports No. 27.

Cleveland, G. C., J. J. Flenniken, D. R. Huelsbeck, R. Mierendorf, S. Samuels, and F. Hassan

1977 Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village Near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report No. 46.

Drucker, Philip

1948 Appraisal of the Archaeological Resources of the McNary Reservoir, Oregon-Washington. Ms. on file, Columbia Basin Project, River Basin Surveys, Smithsonian Institution, Washington, D.C.

Mierendorf, Robert R.

1981 Geologic and Cultural Interpretation of Stratigraphy at the Miller Site, 45FR5, Franklin County, Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Olson, Deborah L.

1983 A Descriptive Analysis of the Faunal Remains From the Miller Site, Franklin County, Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Osborne, Douglas

1957 Excavations in the McNary Reservoir Basin near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Paper 8:1-258.

Schalk, Randall (assembler)

1980 **Archaeological Investigations for the Second Powerhouse Project** at McNary Dam, near Umatilla, Oregon. Laboratory of Archaeology and History, Washington State University, Project Report No. 1.

Schalk, Randall F. (editor)
1983 Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project near Lyons Ferry, Washington. Laboratory of Archaeology and History, Washington State University, Project Report No. 8.

CHAPTER 2

LATE PREHISTORIC CULTURE CHANGE AND SITE STRUCTURE

by

Randall F. Schalk

The Static Model of Late Prehistoric Adaptations on the Columbia Plateau

Plateau archaeologists have commonly depicted the late prehistoric period (2,500 B.P.-Euro-American contact) as an interval of cultural stability. Reduced to its most basic form, the conventional viewpoint has been that adaptations much like if not identical with those described for various ethnographically documented Plateau groups were present throughout this entire time span (Daugherty 1962; Nelson 1973; Brauner 1976). Associated with this viewpoint is a picture of culture change in which traits are cumulatively added without directional transformation (Caldwell 1956; Daugherty 1962). In general, any detectable changes in artifact inventory, settlement pattern, or architectural remains have been attributed minimal significance with respect to any fundamental changes in adaptation. At the beginning of this project, this prevailing viewpoint seemed unsatisfactory.

Probably one of the most obvious defects in the viewpoint of 2,000-3,000 years of relative cultural stability was that it has not been solidly founded upon systematic comparisons of assemblage content from residential sites of differing age. In most cases, any such comparisons have been restricted to stone tool typologies and these have been approached in quite impressionistic and nonquantitative ways. Moreover, the kinds of archaeological evidence most critical to monitoring change in subsistence and settlement have generally been altogether neglected or treated in the most cursory fashion. One can find, for example, very few archaeological sites that have been excavated and reported anywhere in the Columbia Plateau for which information on faunal remains goes beyond a list of species present. More often, faunal remains are not discussed at all. In some instances where more thorough faunal identifications have been made, analytical procedures ignore intrasite assemblage variability and attempt to generalize from faunal "aggregates" spanning thousands of years by combining all remains from one site into a single analytical unit (c.f., Lyman 1976:115). Traditional assumptions about prehistoric subsistence adaptations generally find their way into the conclusions of most studies with, at best, only shreds of empirical support.

A second major weakness that is recognizable in most investigations of late prehistoric residential sites in the Plateau has

to do with the ways in which they have usually been excavated. Variations in housepit form and content have frequently been approached in a strictly normative way:

> In the past it has been assumed that there is a certain uniformity in the characteristics of Plateau dwellings, consequently little attention has been directed toward such details as size, shape, and locations of hearths, associated cache pits, floor conformation, etc. The multiple floors commonly found in these pits are frequently treated as secondary features and have rarely been regarded as distinctive characteristics worthy of independent investigation. . . . The more restrictive approach to the description and comparison of dwelling forms seems to be an outgrowth of the tacit assumption that the Columbia Plateau was an area of cultural homogeneity (Caldwell and Mallory 1967:73).

Since this statement was written, the situation has not significantly changed. Excavation strategies in Plateau archaeology have rarely been directed at attempting to identify relationships between houses and features in pithouse village sites. Ordinarily, one or only a few houses or areas within a site, whether it is large or small, are excavated. Beyond very obvious stratigraphic relationships or marked differences in radiocarbon or typological age estimates, it has been difficult to deal with oranizational patterns that might extend beyond the individual domestic unit and its archaeological manifestation (the individual housepit). Recognizing this methodological handicap at the present, it is necessary to admit the possibility that monitoring cultural change in the archaeological record also is severely limited.

The situation is analogous to the biologist who only studies the body cells of organisms. The cells of quite different species might appear to be remarkably similar and yet be combined into vastly different relationships in various species. The cell, as a level of analysis, would probably be quite inadequate for identification and delineation of relationships at higher levels of oranization. The biologist, however, normally has the advantage of having a complete organism within which it may be assumed that the individual components (cells and organs) stood in some relationship to each other and that all of the components of the organism shared some integrity. Even then, he is severely restricted in his capacity to study relationships at higher levels of organization such as population biology or the social organization of the species. Like this imaginary biologist who investigates cells to find out about the population biology of a species, Plateau archaeologists have usually investigated late prehistoric residential sites as if the individual housepits present on them were partitive units from which normative generalizations could be derived.

If these sorts of methodological limitations are admitted, it must also be recognized that any conclusions about the degree of stability in the adaptations of the late prehistoric period of Plateau

prehistory are grounded more in opinion than on any empirical base. The consensus of opinion that there has been little change in adaptation during the past 2,000-3,000 years of Plateau prehistory has not come to grips with the fact that minimal evidence has been mustered to support that assumption other than that housepits appear to persist throughout that sequence. In fact, it might as reasonably be argued that there are detectable changes in faunal assemblages, size, spatial organization, and internal composition of housepits, mortuary practices, settlement locations, and technology. Due to the assumptions and methodologies that have guided most Plateau archaeology, the late prehistoric period may well be an interval of substantial cultural change which has simply not been well documented and, therefore, for which no explanations have been proposed.

The Accretional Model of Large Housepit Site Occupation and Settlement Plan

Temporal trends in the size and internal structure of late prehistoric residential sites have been summarized previously (Schalk 1980:29-36). The discussion in this section is focused specifically upon the exceptionally large housepit sites of the Middle Columbia Valley. When compared to other areas of the Plateau, this region is unusual for the number of very large housepit sites, many exhibiting more than a hundred surface depressions. It might be argued that these sites are distinguishable from other housepit sites by factors other than their size. The limited evidence presently available indicates that the housepits on these sites are usually relatively recent in age. Several occur on islands and some of those that do not may have been on islands at the time they were occupied (e.g., 45BN53; Osborne 1957). Other characteristics of such sites is that they tend to contain a wide size range of surface depressions and these depressions are spatially organized in a manner that cannot be explained simply by the size and configuration of the inhabitable landform. The point being made by listing these characteristics is that there is some reason to suspect that the large, late prehistoric sites of the Middle Columbia may be more than quantitatively distinct from other prehistoric housepit sites. Though there has been ambivalence and uncertainty among those who have investigated such sites, the general belief has been that these sites represent the accretional build-up of numerous occupations by small groups of people. In this respect, this class of sites has been conceptualized as being only quantitatively but not qualitatively different from other housepit sites.

In perhaps the earliest systematic investigation of a large housepit village site of 132 depressions on an island at the mouth of the Deschutes River in 1924 (45KL104), Strong et al. (1930:29) hesitantly suggested the possibility of a very large contemporaneous occupation of the site.

> Whether all of the houses indicated by these pits were inhabited at any one time cannot be determined. It does not

> seem likely. Yet, as in no cases does one ring cut into another, the lodges must have been fairly contemporaneous, and it seems probable that the village had a large population (Strong et al. 1930:24).

At a large housepit site with 182 surface depressions located about nine miles above Plymouth, Washington, in the McNary Reservoir (45BN53), excavation information was used with some ambivalence to argue a basic accretional model of site development (Osborne 1957).

> Excavation has shown that the small pits were used as dwelling pits. Other than this nothing can be said as to the village plan although there are some vague groupings visible on map 2--which are probably fortuitous. The suggestion should be made that the large number of pits here may well be a result of the relatively easy digging in sandy soil (Osborne 1957:9).

> As can be seen from the few foregoing remarks, there is much to be done on the problem discussed. . . . It is especially important to map several other large pithouse sites and test the conclusion that there was no village plan (Osborne 1957:10).

Noting that there were significant differences in the depths of various surface depressions, Osborne (1957) suggested that such differences might be due to the recency of their abandonment.

> The nature of the soil, the plant cover, and . . . the fact that pits were often partly cleared out and reused prevent the basing of any definite conclusions as to age on the depth of the pits. Each of the 182 pits would have to be excavated to determine relative ages. Judging on the basis of the pits excavated, which all showed plural occupation, <u>it would appear that only a small percentage were inhabited at any one time</u> (Osborne 1957:15; emphasis added).

In 1951, the Smithsonian crews excavated trenches and test pits at Strawberry Island village (Osborne and Crabtree 1961). The conclusions drawn regarding the process by which a large housepit site was formed still leaned strongly toward the accretional model though with some obvious contradictions.

> It is doubtful that the two groupings of pits, the northeasterly [northwesterly] and the southeasterly reflect any more than the facts that houses near the water were preferred and that there was a large enough population so that both banks were used as living space. The vague clumping within the two main groups may indicate a living preference or relationships of those who dwelt in the houses. Other than this no village pattern emerges (Osborne and Crabtree 1961:19).

> The propinquity of the various pits would indicate that occupation was scattered and that not all or even a large percentage of the pits were dwelling places at one time. House pits were probably dug anew or cleared and dug out by each dwelling group, probably each family, rather frequently. The soil is friable and a pit soon loses its shape, becomes enlarged by bank slumping and erosion. It would often be a problem of new timbers or a new house pit the latter was by far the simpler solution (Osborne and Crabtree 1961:25-26).

It is clear from these statements that Osborne and Crabtree were aware of certain inadequacies in the accretional explanation for the distributional pattern of housepits at Strawberry Island; as a result, their own statements are incompatible.

If it is assumed that an average of four persons occupied each household and that all surface depressions at Strawberry Island were domestic facilities, a contemporaneous occupation of all visible housepits on the site would require a group size on the order of 500 persons (Cleveland 1976:11). Since housepit sites ranging from 1 to 20 surface depressions are widely documented throughout this and other regions of the Columbia Plateau, it is not surprising that there has been a general preference for the accretional model of large housepit site formation. Aside from certain assumptions about the character of local group sizes in late Plateau prehistory and the stability of adaptation that is believed to have prevailed throughout this lengthy interval, what is the evidence that has been offered in support of the accretional model? The answer seems to be simply that many or most of the housepits that have been explored in these sites showed evidence of multiple occupations, but this fact is hardly conclusive evidence.

It has been suggested previously that the long and scattered distributions of housepits on certain river bars might indeed be the result of a long-term accumulation of separate episodes of occupation (Schalk 1982:186). Given that the various locational determinants regulating winter residence placement are satisfied along a lengthy linear zone of a floodplain, one might expect a cumulative process of housepit formation as relatively small local groups repeatedly occupy partially nonoverlapping areas within that zone over the centuries. While it is likely that such a process plays a role in the development of some distributional patterns of housepits along the Middle Columbia, this explanation does not adequately account for the spatial distribution of the surface depressions at the sites under discussion.

One difficulty with an accretional model of the sort referred to is that it does not account for the cohesively distributed, large groups of housepits along a few hundred meters of river bank. The accretional model seems much more consistent with the scattered distributions that sometimes occur for a mile or more along various river bars of the Middle Columbia (Lee 1955:site 45GR77).

Another difficulty with the accretional model is the assumption that aboriginal people would preferentially invest large efforts into

the digging of new pits for their dwellings rather than re-occupying existing pits located, at most, 50-100 m away. This point is also discussed by Mierendorf (Chapter 4) and it is only necessary here to point out that excavation of a new pit would involve removal of several cubic meters of earth as opposed to much smaller volumes, if any, required for the renovation of an old pit. That aboriginal people would ordinarily behave in this manner is neither consistent with minimization of effort or the recognized fact that most housepits do evidence multiple episodes of usage.

Spatial Distribution and Variation of Surface Features

Because of its location on an island, the Strawberry Island housepit Village has escaped the ravages of surface disturbances that are widespread along the banks of the Snake and Middle Columbia in this region. While the lower end of the site was farmed until the late 1940s, the area upstream from the upper flood chute that crosscuts the island has never been cultivated. The island setting has also protected the site from intensive vehicular traffic. As a result of these factors and perhaps others, the aboriginal surface features on this site are as clearly visible and well defined as any to be seen anywhere in the Columbia Plateau.

Surface depressions are scattered continuously in two major clusters along either side of the upper end of the island. With the exception of fire-broken rock, cobble implements, and broken animal bones scattered along the foot of the cutbanks and shoreline of the site, there is little surficial evidence for aboriginal occupation other than the housepit depressions across most of the site. The site surface is generally devoid of cultural material except where archaeologists or relic hunters have brought buried materials to the surface. The deposition of flood sediments during unusually high water periods in the past century has blanketed the island with several centimeters of protective covering that obscures cultural material immediately below the surface (Mierendorf, Chapter 4).

During the Smithsonian River Basin Survey investigation of the site in 1951 (Osborne and Crabtree 1961), a total of 131 housepit depressions were recorded. Mapping efforts carried out by WSU in 1976 and 1977 identified a total of 133 depressions that were visible on the surface of the site. The distribution of surface depressions in these two mapping efforts corresponds reasonably well and it is clear that there has been limited modification in the surface of the site during the past 30 years. The only exceptions may be that two areas may have experienced partial or complete erosion of a few housepits, specifically: the vicinity of depressions 96, 117, and 119 on the southeast shore of the site and the northern margin of the upstream flood chute or swale that cuts through the island[1].

Housepit features are clearly distinguishable on aerial photographs taken of the island by the Corps of Engineers in 1952

(Figure 2-1). Though the distribution of the dark blotches on this aerial photograph correspond remarkably well with the distributions that have been documented through mapping, it is also apparent that additional features are evident on the photograph. Since most of these dark spots correspond remarkably well with documented housepits, it seems likely that many of the additional spots evident in the photo are also housepits. This would suggest three possibilities; that additional depressions were present on the surface in 1952 that have been subsequently obscured, that a number of surface depressions are so subtle that they were not noticed during mapping activities in recent years, or that subsurface features contribute to slight differences in vegetation and/or soil characteristics that are visible in an aerial photo but not detectable on the ground. The last two explanations seem to be most likely and one suspects that both have an effect. In any case, there are many reasons to believe that the aerial photographs and map available for this site provide a reasonably reliable picture of housepit spatial distributions.

Following standard convention, right and left banks of the island references in the discussions to follow and throughout the remainder of the report assume that the observer is facing downstream. In terms of directions of the compass, the right and left banks are the northwest and southeast sides of the island, respectively.

Inspection of the aerial photograph and site map indicated several interesting characteristics of this distribution of housepits across the site. The most salient characteristic is that the two clusters of depressions on either side of the island differ markedly in the spacing of individual depressions with respect to each other and in their average sizes. The right bank cluster contains numerous smaller subclusters of 4-10 depressions. In at least three of these subclusters there is a well-defined circular arrangement of depressions around one or two centrally placed depressions. In another subcluster there is a rectangular compound-like arrangement of housepits surrounding two that are centrally positioned.

On the right bank of the island, depressions are densely packed in close proximity. Both large and small depressions occur throughout the entire right bank cluster. Within the left bank cluster, there is minimal indication of smaller subclusters with spatial coherence. Spacing between depressions is noticeably greater and depression sizes are larger on the average than those of the right bank. Mean depression area for the left bank is 50.3 m^2 but only 36 m^2 on the right bank. Very small depressions which are so frequent on the right bank are virtually nonexistent on the left bank. The largest depressions tend to be centrally positioned within the entire left bank cluster.

For purposes of comparison, the areas of each depression for which measurements have been taken were computed. Histograms of depression areas arranged by 5 m^2 size classes for the entire site and for the two sides of the island are shown in Figure 2-2 and 2-3. It is apparent that there are substantial differences in the frequencies of the depression size classes for the two sides of the island. It is

Figure 2-1. Aerial photograph of Strawberry Island taken in 1952 showing housepits as dark spots (photo courtesy: US Army Corps of Engineers). Light areas represent disturbed vegetation and sediments associated with the River Basin Survey testing effort at the site in 1951.

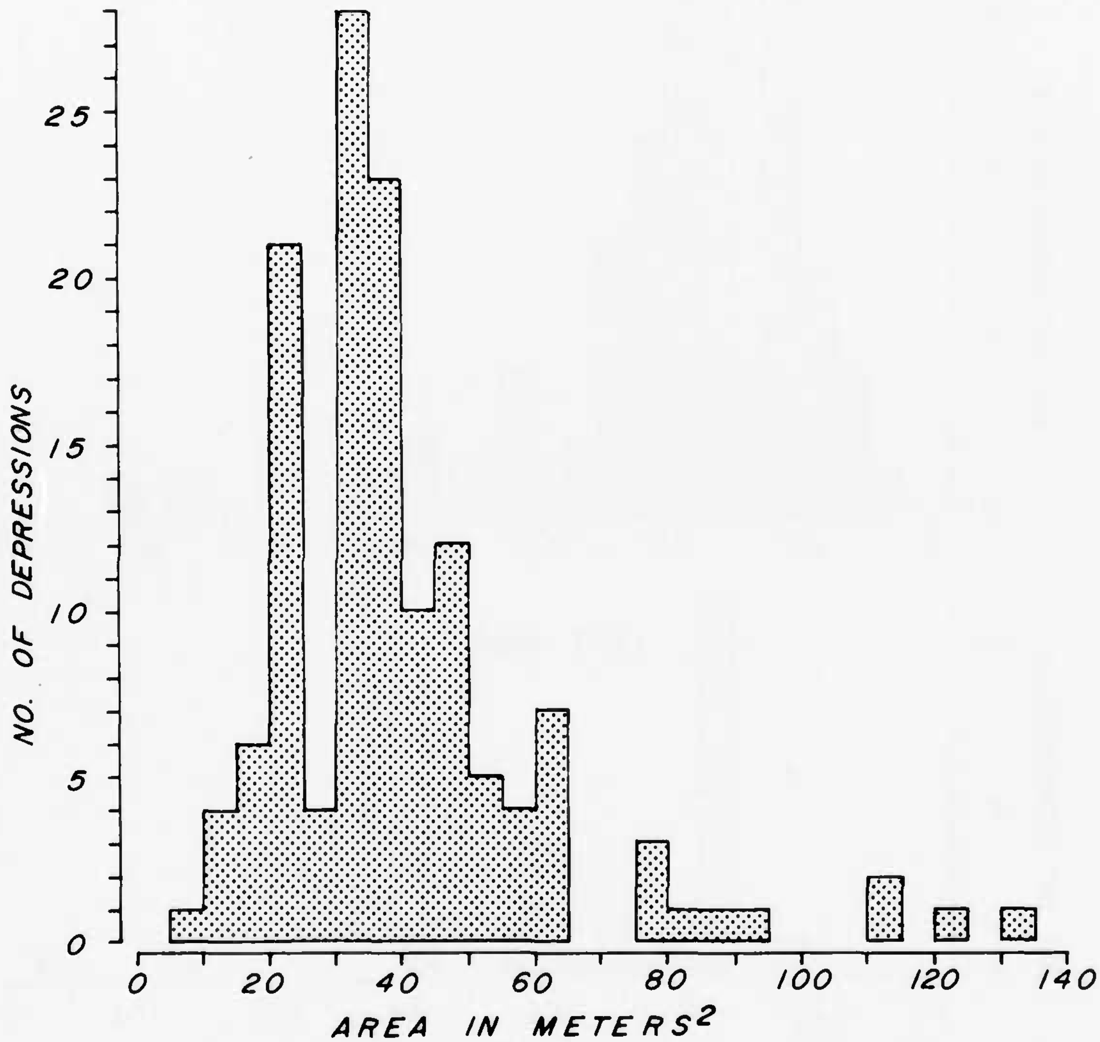


Figure 2-2. Histogram of all surface depressions at Strawberry Island arranged by 5 m^2 size classes.

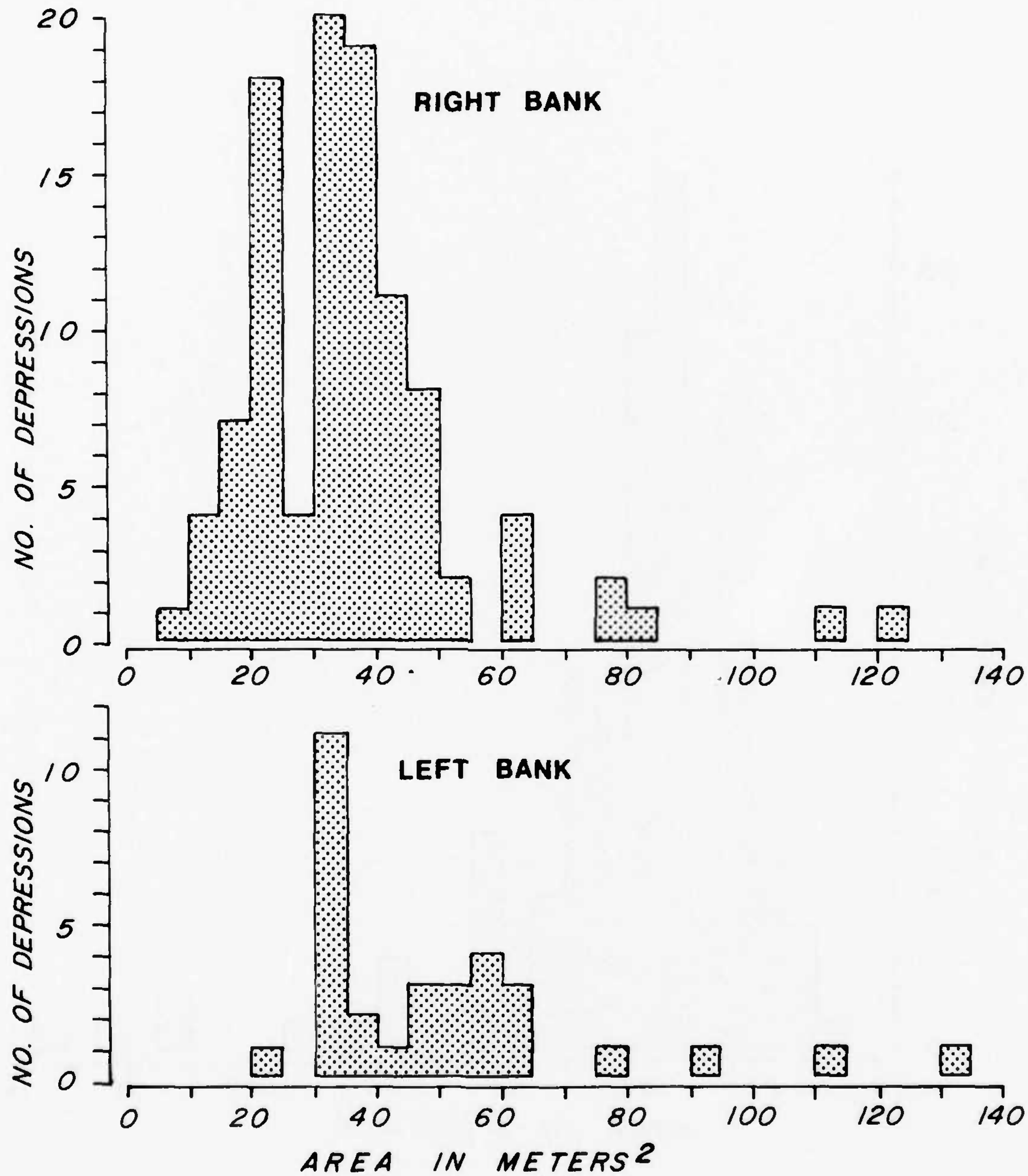


Figure 2-3. Histogram of depression areas for the right and left bank clusters at Strawberry Island.

especially interesting that housepit size variations are noncontinuous. In the right bank cluster there is a four-modal curve. This distributional pattern in size classes seems to closely approximate that for 45BN53--another large housepit site downstream in the McNary reservoir that is now inundated and which has been discussed in earlier sections of this report. The primary difference between the histogram for 45BN53 and that of right bank cluster at Strawberry Island is that the latter tends to have a higher frequency of slightly larger housepits (Figure 2-4). This contrast was noted and discussed by Osborne and Crabtree (1961:24).

As Osborne and Crabtree also noted (1961:23), depth of depressions correlates roughly with depression diameter. Mean depression depth on the left bank is in fact 0.35 m whereas on the right bank only 0.30 m although such a minor difference may be of questionable significance.

In general then, comparisons of surficially visible structural remains from the two major portions of the site indicated that there were substantial differences in spatial arrangements and mean size. These differences seemed to offer a distributional pattern worthy of further investigation.

Chapter Summary

Three interrelated research questions have been identified in this chapter. The first and most general had to do with the degree to which late prehistoric adaptations preceding the arrival of the horse in this region were unchanging. The widely held belief that cultural change was minimal between the initial appearance of housepit villages in the Southern Plateau and the arrival of the horse nearly 3,000 years later was brought into question on theoretical, empirical, and research grounds.

The second question had to do with the occupational history of large and spatially coherent housepit sites such as Strawberry Island. It was argued that the "accretional model" for the development of such sites, while it may be consistent from some perspectives with the long-term stability model for late prehistoric adaptations, does not seem entirely consistent with the patterning of structural remains evident at these sites. That is, the large housepit sites referred to exhibit a degree of spatial order and structure not easily anticipated from a simple accretion model.

The third question had to do specifically with the significance of detectable intrasite differences in structural remains at Strawberry Island. Substantial differences between two large housepit clusters on the site raise the question of what, if any, differences in architecture and assemblage content might be correlated with the contrastive surface patterns. Here again, a view of late prehistory in the Plateau as a relatively undifferentiated continuum would tend to minimize the

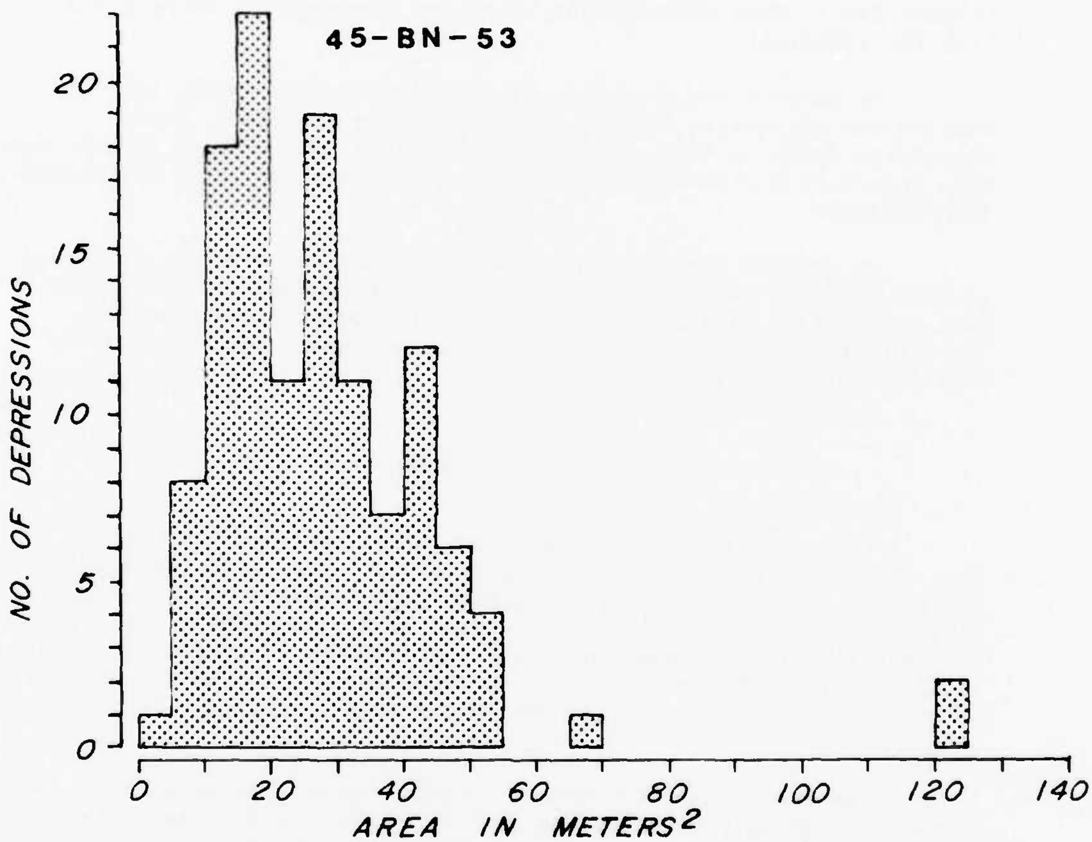


Figure 2-4. Histogram of surface depression areas for 45BN53. Data derived from Osborne (1957:Table 2).

significance of such differences. At the very least, that view would deny any temporally distributed differences.

NOTES

1. Figure 8-3, which was developed from comparisons of aerial photographs taken in 1952 and in 1976, indicates that at least 10 complete housepits and portions of five others may have been lost during this interval.

REFERENCES CITED

Brauner, David R.
1976 Alpowai: The Culture History of the Alpowa Locality (Vol. I-II). Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Caldwell, Warren W.
1956 The Archaeology of Wakemap Mound: A Stratified Site Near the Dalles on the Columbia River. Unpublished Ph.D. dissertation, Department of Anthropology, University of Washington, Seattle.

Caldwell, Warren W. and Oscar L. Mallory
1967 Hells Canyon Archaeology. Publications in Salvage Archaeology, No. 6. River Basin Surveys, Lincoln.

Cleveland, Gregory C.
1976 Introduction and Overview, the Miller Site, Strawberry Island, 45FR5. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village Near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Reports Number 46.

Daugherty, Richard D.
1962 The Intermontane Western Tradition. American Antiquity 28: 144-150.

Lee, Warren T.
1955 An Archaeological Survey of the Columbia Basin Project in Grant County, Washington. Davidson Journal of Anthropology 1(2):141-153.

Lyman, Richard Lee
1976 A Cultural Analysis of Faunal Remains from the Alpowa Locality. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Nelson, Charles M.
1973 Prehistoric Culture Change in the Intermontane Plateau of Western North American. In The Explanation of Culture Change: Models in Prehistory, edited by Colin Renfrew. University of Pittsburgh Press, Pittsburgh.

Osborne, Douglas
1957 Excavations in the McNary Reservoir basin near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Paper 8:1-258.

Osborne, Douglas and Robert H. Crabtree
1961 Two Sites in the Upper McNary Reservoir. Tebiwa 4(2):19-36.

Schalk, Randall
1980 The Cultural Sequence of the Southern Columbia Plateau. In Cultural Resource Investigations for the Second Powerhouse Project at McNary Dam, Near Umatilla, Oregon, assembled by R. F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Report Number 1., Pullman.

1982 The Regional Environment. In An Archaeological Survey of the Priest Rapids Reservoir: 1981, edited by R. F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Report Number 12.

Strong, William D., Egbert W. Schenck, and Julian H. Steward
1930 Archaeology of the Dalles-Deschutes Region. University of California Publications in American Archaeology and Ethnology, 29(1). Los Angeles, California.

CHAPTER 3

EXCAVATION STRATEGY

by

Randall F. Schalk

Introduction

The 1976 and 1977 seasons of work carried out by Washington State University (Cleveland et al. 1977; Cleveland 1978) concentrated on excavating housepits which were either already partially destroyed by erosion (D-117, D-76) or imminently threatened by bank slumping (D-119, D-96). In addition, an area outside of the visible surface depressions was tested (Open Area 200). Excavation units from the 1976-1977 seasons are shown in Figure 3-1. The 1976 season involved two major activities:

1. Mapping the site using a combination of on-the-ground and photogrammetric techniques; and

2. Partial excavation of three housepits on the southeast side of the upper end of the island which were already undergoing bank erosion (D-119, D-117, D-96).

In 1977, excavations of these three housepits were continued and excavation was extended to a fourth depression on the opposite side (right bank) of the island (D-76). In addition minor excavations were made adjacent to the excavations in D-76 in an area where no visible depressions were present on the surface. Generally, the effort of these first two seasons was directed toward the recovery of good locational data on lithic and faunal materials from a few houses.

By the completion of the 1977 season, a number of facts about the site had been established. All evidence from excavations up to this time indicated that the site was entirely prehistoric--no trade items of glass or metal, horse bones, or other post-contact materials had been found. This finding gave further support to the results of the 1951 Smithsonian test excavations which indicated exclusively late prehistoric deposits at the site (Osborne and Crabtree 1961). A series of eight radiocarbon dates from housepits excavated during 1976 and 1977 spanned a relatively narrow range of about four centuries (600-200 B.P.). In addition, data on the internal structure of houses, as well as activity areas, tool inventories, and kinds of faunal and lithic debris they contained had been obtained. The map that was made of the site constitutes what is probably the most extensive and accurate data on intrasite distribution of surface features available for any large housepit site in the Columbia Plateau.[1] Recovery of the faunal and

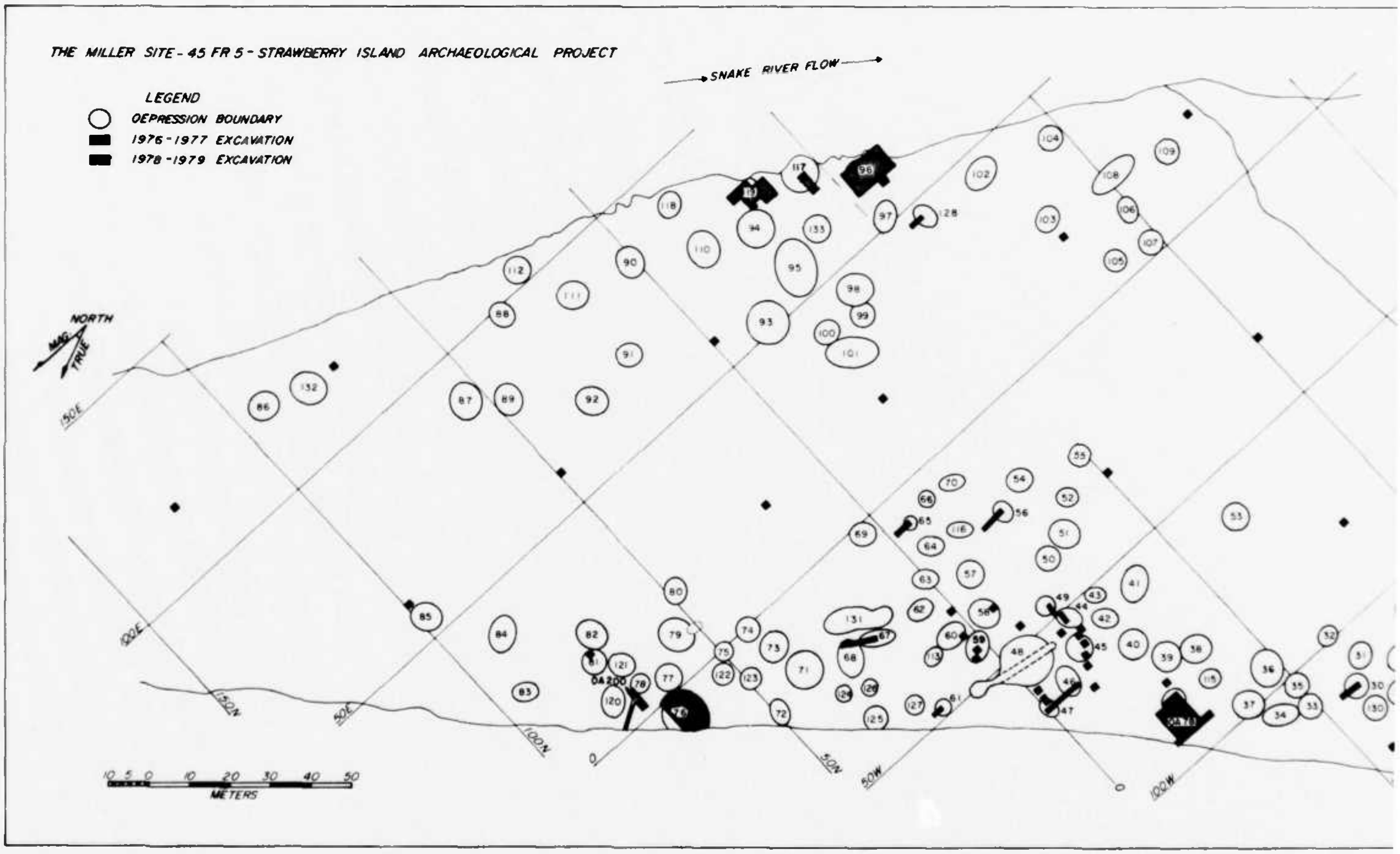
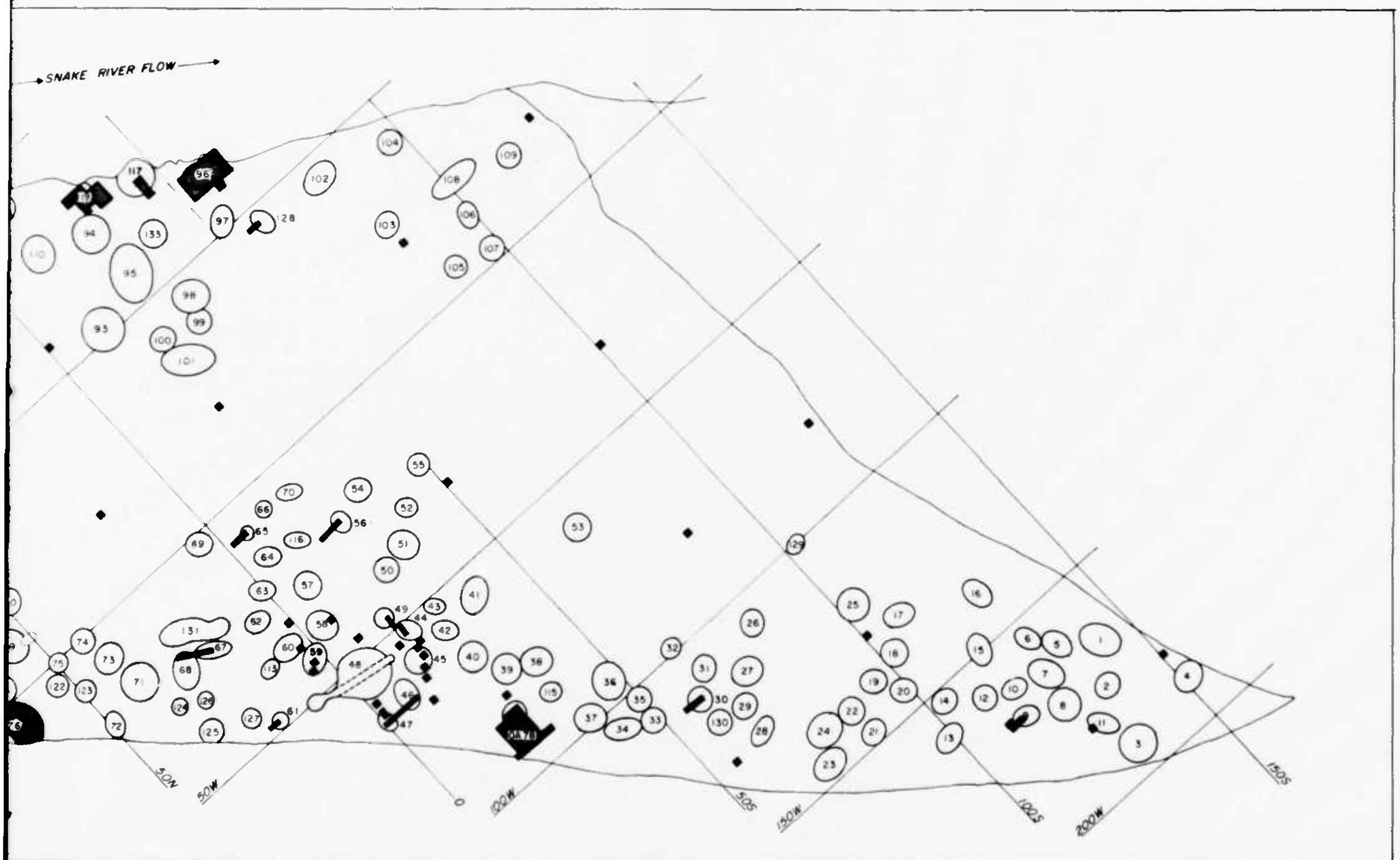


Figure 3-1. Map of the site showing depression locations and 1976-1979 excavations.



cations and 1976-1979 excavations.

lithic assemblages provided the basis for analyses which have established models of artiodactyl butchering and processing sequences (Cleveland 1977; 1978) and lithic manufacturing trajectories. In addition, tentative information was collected on the island's natural and cultural stratigraphy that provided preliminary insights into the site's depositional history (Mierendorf 1977). In short, while the efforts had been predominantly concerned with salvaging a small portion of the site, a good foundation was laid for continuing effort to assess the significance of the entire site.

The 1978 Season Excavation Strategy and Procedures

In planning the 1978 excavation, it was decided that a major emphasis should be placed upon determination of how areas previously excavated related to the rest of the site and how variability documented in the 1977-1978 excavations represented that occurring across the entire site. The first two seasons of work had recovered data on spatial organization _within_ houses. It seemed that spatial patterning at a larger scale would be critical to provide a context for the finer-grained organization within a few houses that had been intensively excavated. The fact that architectural features are relatively well-defined on the surface of the site made it possible to center a sampling design on these as a first step in identifying the range of variation in features across the site. Accurate identification "of the use, form, function, condition, and size of those elements making up the archaeological record" is essential to any higher level interpretations that might follow (South 1979:213). Even if it were assumed that all of the depressions on the site represented domestic facilities (and it was not), the diversity in these required exploration if meaningful conclusions could be drawn about their spatial arrangements.

The sample was planned with the intention of making maximum use of information already available from previous excavations. In this sense, it could not be considered entirely probabilistic but to ignore extant data at the cost of considerable additional earthmoving did not seem to warrant a purely probabilistic design. Data from excavation in a variety of depressions during the River Basin Survey testing done in 1951 on the site as well as from the 1976 and 1977 excavations was substituted in fulfilling a sample aimed at identifying the range of variation that existed in the visible surface features on the site.

The 133 visible depressions which had been mapped on the site were first stratified on the basis of three attributes--size, shape, and in which of the two major depression clusters they occurred. The information on each of these attributes were taken from the mapping data collected during the previous seasons.

Depression size was selected as an important quality of these features for several reasons. Diameters of the depressions on this site ranged from as little as 2 meters to more than 16 meters. Previous excavations on the site had not probed a very wide range of depression

sizes and generally had focused upon those near the large end of the spectrum. This same selection bias may well be the case for the Plateau generally.

A second reason we thought size might be important was that a histogram of depression areas plotted for the site (see Figure 2-3) revealed at least four distinguishable size groups. Though Osborne's crew took diameter measures on the depressions on Strawberry Island in 1951 (Osborne and Crabtree 1961), these data were presented in terms of mean values so that we could not determine the dimensions of particular houses. It was our initial suspicion that this apparent noncontinuous variation in depression areas might be an artifact of the map-maker's procedures. He had utilized a series of engineering templates ranging from circular through highly elliptical in plotting the depressions. Utilizing the three elevations taken around the rim of each house during the field mapping, he had made the best fit through these three points with a template. It was recognized that what we perceived as noncontinuous variation in depression size range indicated on the map could in fact be due to noncontinuous variation in the drafting templates. The histogram of depression areas for 45BN53, the large housepit village downstream in the McNary Reservoir, seemed to support the interpretation that that this pattern was not an artifact of the map preparation techniques. Absolute rim-to-rim diameters had been taken across the north/south and east/west axis of each depression on that site so that areas could be directly calculated. This histogram (Figure 2-4) also showed noncontinuous variation and repeated an apparent pattern of three or four discernible size groupings. For this reason, the noncontinuous size variations seemed to be real and of potential importance as a dimension in the sampling procedure. Three size classes were distinguished for sampling purposes based upon a measure of the long radius of each surface depression taken from the 1977 map. These classes were: (1) 1 meter to 3.5 meters in diameter, (2) 3.5 to 6 meters in diameter, and (3) greater than 6 meters in diameter. A number of archaeologists have suggested temporal patterning of housepit sizes (c.f., Shiner 1961:225; Nelson 1969:99), and size might also be expected to vary with differences in function (Osborne 1957:9). Sampling procedures were intended to detect both sorts of variability across the site.

Depression shape was identified as a second dimension of variability to be represented within the depressions sampled. The two major shape distinctions that were observable from the map were circular and elliptical. Our measure of depression shape, then, was based upon a ratio of the long radius divided by the short radius for each depression. For the purposes of the stratification, ratios of 1:1 to 1:1.3 were considered round (r) and radius ratios that were more than 1:1.3 were considered elliptical.

Side of island was selected as the third attribute of the surface depressions. There are two major and distinct clusters on either side of the island (see Figure 2-1 and 3-1). There were some rather obvious differences within these two clusters with respect to mean sizes of depressions as well as the way in which they were spaced

within either cluster, and it was felt that this distinction should be reflected in the sampling procedure. Admittedly, other smaller clusters are also apparent, but it was less obvious how we could stratify on the basis of these and to introduce several additional categories in the stratification would necessitate far more excavation than we could realistically attempt.

Before proceeding with the discussion of the depressions tested in 1978, it is necessary to discuss how they relate to those previously tested in the Smithsonian excavations (Osborne and Crabtree 1961) and those of WSU in 1976 and 1977. Table 3-1 lists those depressions that were tested in the 1951 Smithsonian excavations. Since the depression numbering system was changed by Cleveland in 1976, both the Smithsonian and WSU numbers are listed for each depression tested by Osborne and Crabtree.

The WSU excavations of 1976 and 1977 involved large block excavations in Depressions 76, 96, 117, and 119. In addition, backhoe stratigraphic trenches were placed in Depressions 25 and 58 (see Hassan 1977). Attribute combinations for each depression excavated both by Osborne and Crabtree (1961) and Cleveland are listed in Table 3-2.

A schematic representation of all the surficially visible depressions across the site stratified by size, shape, and side of island is shown in Figure 3-2. Once this chart was constructed, distributions of depressions in each class were examined to determine how variability with respect to the three attribute combinations had been represented in the earlier excavations of Osborne and Cleveland. The sample of depressions tested in 1978 was drawn then to complement those already represented in the earlier excavations. Although the housepits investigated in the previous excavations were selected judgmentally, those chosen for testing in 1978 were drawn randomly from within those strata not represented or underrepresented in the samples of Osborne and Cleveland. While such a sampling procedure is only an approximation of a stratified random sample of housepits from the site, stricter adherence to such a sample would have required ignoring much of the earlier work at the site, much more earthmoving than was possible within the manpower and funding constraints of the project, and ultimately a greater degree of disturbance to the site. The sampling procedure outlined above seemed to be a reasonable compromise to these other considerations.

The actual procedure utilized in testing the depressions drawn for the 1978 sample involved excavation of a meter wide trench from outside the rim to the center of each depression in the sample. These trenches were positioned uniformly from the north edge of each depression rim (Figure 3-1). The intent of a uniform orientation of the trenches with respect to the depressions was to minimize variability in the sample that might arise from any systematic internal patterning of features, structural elements, artifacts or debris. A single exception to this positioning procedure for the test trenches occurred in an elliptical depression (D-67) for which a trench entering from the north rim to the center of the depression would have cut obliquely through the

Table 3-1. Depressions tested by Osborne and Crabtree in 1951

Osborne and Crabtree Number	WSU Number	Excavation Type
1 and 2	48	Trench (86' long)
78	108	Block (19 5'x5' units)
87	3	Pit (5'x5')
67	101	Pit (5'x5')
59	117	Pit (5'x5')
89	9	Pit (5'x5')

Table 3-2. Attribute combinations for all depressions tested before 1978.

Depression Number (WSU Number)	Excavated By	Attribute Contribution (Cluster, Size, Shape)
3	Osborne and Crabtree	N 2 R
9	Osborne and Crabtree	N 1 R
25	Cleveland et al.	N 2 R
48A	Osborne and Crabtree	N 3 R
58	Cleveland et al.	N 2 R
76	Cleveland et al.	N 2 R
96	Cleveland et al.	S 2 E
101	Osborne and Crabtree	S 3 E
108	Osborne and Crabtree	S 3 E
117	Osborne and Crabtree, Cleveland et al.	S 2 R
119	Cleveland et al.	S 1 R
48B	Osborne and Crabtree	N 1 R

Table 3-3. Depressions tested in 1978 and excavation unit sizes in each.

Depression Number	Trench Dimensions
D-9	1m x 4m
D-128	1m x 3m
D-56	1m x 6m
D-30	1m x 5m
D-67	1m x 7m
D-61	1m x 3m
D-65	1m x 5m
D-114	1m x 4m

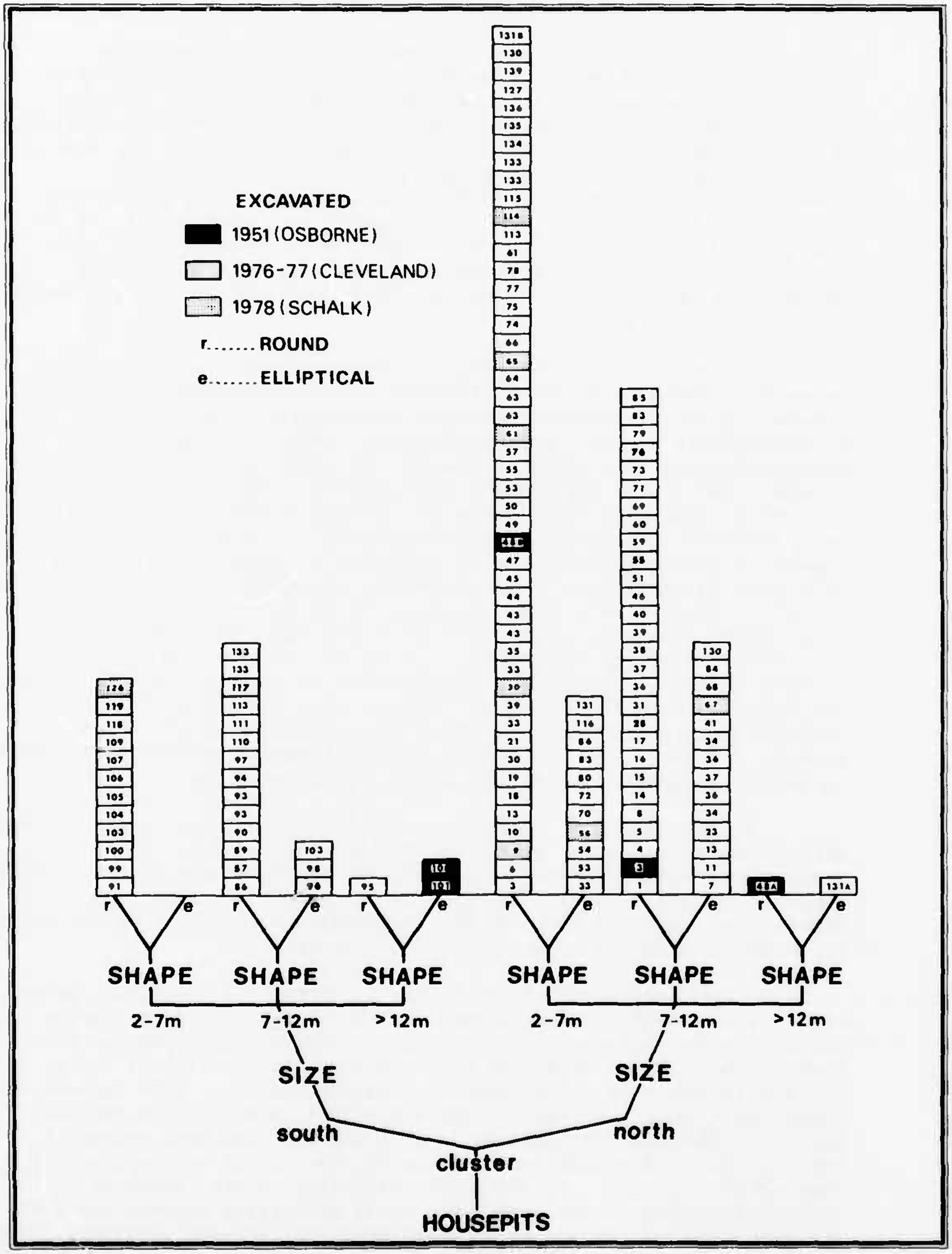


Figure 3-2. The sampling scheme for 1978 showing the classes generated from three housepit attribute dimensions.

housepit feature. In this single case, the trench was parallel to the long axis, which trenched northeast-southwest.

Depending upon the size of individual depressions, these trenches varied from three to seven meters in length. Dimensions of test trenches for each of the eight depressions sampled in 1978 are listed in Table 3-3. Excavations were carried out by shovel skimming in 10 cm arbitrary levels and screening through 1/4 inch (625 mm) mesh hardware cloth. Proveniences of all artifacts and debris were maintained within 50 cm by 50 cm horizontal units. Each trench was excavated to the sterile river cobble layer that underlies all of the fine-grained sediments across the island. After completion of each trench, stratigraphy was recorded in an exacting way and sediment samples were removed from the various depositional units in each trench (see Mierendorf, Chapter 4).

It was intended that these trenches through a sample of the depressions would be the most efficient means for recovery of information on the nature of housepit construction, variations in artifact/debris content, presence/absence, positioning and superpositioning of hearths, frequency and nature of re-occupation episodes, and ultimately insight into possible functional variations in the use of these features. Given the obvious limitations imposed by short trenches in sizeable housepit features, cutting through the rim seemed the most reasonable way of obtaining a sample of small items (bones and lithics) that would adequately represent the variability of the entire house. This supposition was based on earlier identifications of a "midden ring" around the margins of housepits (Cleveland 1978:34-35) which was assumed to be comprised at least partially of secondary refuse. The midden ring promised to yield samples of lithics and faunal remains that would be "coarse-grained" (Binford 1978) compared to those one might encounter on a house floor or between houses. A "coarse grained" sample was considered desirable in the sense of being representative of many events rather than one or a few.

At the same time, the same trenches could be utilized along with other excavations on the island in stratigraphic studies of the depositional history of the island and the relationships of the cultural deposits to that history. The results of the stratigraphic and depositional analysis of these test trenches are presented by Mierendorf in another section of this report (see Chapter 4).

After completion of the eight test trenches, the second major effort of the 1978 season involved initiation of a block excavation adjacent to but outside of surficially visible housepits on the right bank of the island. This side of the island has the largest number of visible surface depressions and, as mentioned earlier, mean depression sizes and spacing patterns are quite distinct from those on the left bank. In addition, excavations in 1976 and 1977 had been primarily concentrated on the left bank because of the impacts of erosion that were occurring there. It was anticipated that several kinds of information could be obtained using these excavation methods and that the resulting information would complement that already available. The kinds of information sought included:

1. stratigraphy and occupational history from an area of the site that promised to be less extensively mixed by episodes of house reoccupation, cleaning, and rebuilding;

2. faunal and lithic collections that could be compared to those available from within housepits;

3. possible temporal changes in assemblage content that had not or could not be recognized in the relatively small samples recovered from the complex deposits associated with housepits; and

4. features and activity areas not represented by excavations within housepits.

The actual placement of this block excavation (see Figure 3-1) was done judgmentally. It was positioned between two surficially visible small depression clusters and the river bank with the assumption that this location would be a good one for the investigation of activities occurring outside of houses. This excavation involved an area of 57 square meters. Owing to a combination of high densities of cultural material, a time-consuming piece-plotting excavation technique and overly optimistic estimate of the amount of time it would take to excavate down to sterile horizons, this unit was extended only to a depth of 30 or 40 cm (depending upon the unit) during the 1978 season.

The 1979 Excavation Strategy and Procedures

The 1979 fieldwork was comprised of three major efforts. The first was to define site boundaries more precisely and artifact/debris density variations with small, systematically spaced test pits. The second effort was to investigate the variability within a single, coherent cluster of housepits that appeared likely to have been contemporaneously occupied. The third effort involved the completion of the block excavation (Area OA-78) initiated in 1978. These three aspects are discussed in greater detail in the remainder of this chapter.

By the beginning of the 1978 season, it was apparent that previous investigations of the site had been limited to the vicinity of visible surface depressions. In particular, it was impossible with existing information, to evaluate how the areas of the island with surficially visible housepits related to a potentially larger distribution of cultural material that lacked such surface evidence.

Lacking information on the subsurface distribution of occupation debris away from the housepits, it was unclear whether the cultural deposits of the site were noncontinuous between the two banks of the upper island even though the surficially visible features appeared to be. In addition, because cultural material had been noted in previous years in restricted areas along the shoreline of the once cultivated

portion of the island. It was recognized that the distribution of surficially visible housepits might only represent a portion of an even larger distribution which had been obscured by leveling activities and plowing.

Information on site boundaries is, of course, important to future management decisions and generally pre-requisite to listing of a cultural resource on the National Register of Historic Places. In addition, the same information seemed essential to the overall objectives of the project--to document the variability represented across the site and provide a larger context for the limited excavations of small portions of it that had been previously undertaken. To recover such information, a series of 1 m^2 pits were excavated at systematically spaced, 50 m intervals along the east/west axis and 25 m intervals along the north/south axis. These test pits were placed so as to avoid surficially visible depressions. A single exception occurred where the grid-test interval encountered a surface depression (D-81) in an area of the site which had been neglected in previous excavations or those planned for 1979. These 1 m^2 test units were also placed along the perimeter of the island below the flood chute all the way to the lower end of the island. All of these test pits were rapidly excavated in 10 cm levels. Only a relatively small number of these pits ultimately yielded any significant evidence of human occupation and with the exception of a small area at the lower tip of the island, it turned out that the areas with surface depressions on the site conform rather closely with the subsurface distributions of cultural material. Though it was not our intention at the time, these test units were subsequently recognized as a useful check on the extent to which nonhuman sources are responsible for contributing to the faunal assemblage within the site deposits.

The second major aspect of the 1979 season was comprised of a series of tests within a well-defined subcluster of houses on the right bank of the island. This entire subcluster, including depressions 44-48, 58, and 59, was referred to as area 500 in the field and site records. Examination of the 1952 aerial photograph of the site (Figure 2-1) as well as the detailed map generated in 1977, indicated that this cluster of depressions appeared to be spaced in a very regular circular pattern around the largest depression on the entire site. When this large depression (D-48A) was tested by the River Basin Survey Crew in 1951 (Osborne and Crabtree 1961), its content was notably different from other housepits that they tested. It showed no evidence of interior hearths and minimal evidence for occupation. A smaller depression adjacent to it (D-48B) that was tested at the same time showed evidence of multiple intervals of occupation and contained a heavy concentration of lithic and faunal debris. In any case, the circular compound-like arrangement of depressions around a seemingly distinctive and exceptionally large depression suggested that these features would be likely candidates for housepits that were contemporaneously occupied--perhaps by individuals whose social and economic relationships were reflected in this placement of houses. Assuming this possibility, this cluster of depressions promised the opportunity of determining the degree of variability in housepit content that might occur at the level

of individual households within an economic unit that included several domestic units. If some division of labor occurred at a level greater than individual households (and this would not seem unlikely), then one would expect patterned differences in the kinds of remains associated with individual houses. Given the proximity of these depressions, the potential for recognizing contemporaneous occupations seemed better than is generally the case when attempting to relate structures that are more widely spaced. We were aware of the potential difficulties in establishing occupational contemporaneity with any great degree of certainty. It was, however, apparent that evidence for noncontemporaneity would be much easier to recognize and that such a demonstration would greatly diminish any lingering suspicions about the traditional assumption that any regularities in housepit spacing in sites of this kind are "strictly fortuitous." In other words, investigation of housepits in some seemingly structured arrangement offered the opportunity to test the conventional belief that such arrangements do not have any cultural significance. Disproof of a social or economic explanation would be as simple as showing that the various structures were not occupied contemporaneously. Evidence supporting such a conclusion would then imply much about the entire spatial distribution of depressions on this or other similar sites in the Columbia Basin.

Excavations in these depressions were necessarily very limited. A series of pits were spaced so as to maximize the possibility for evaluating their stratigraphic relationships while, at the same time, minimizing the amount of excavation required. The placement of these pits is indicated in Figure 3-3.

The third and final effort associated with the 1979 season of work involved the completion of the small block excavation initiated in 1978 on the right bank of the island (Area OA-78). Excavation here was extended down to the river cobble foundation of the island by the completion of the 1979 field season. Unfortunately, completion of this excavation required relaxing horizontal controls. Though the upper levels were excavated using a three-dimensional proveniencing technique on all artifacts, lithics, fire-cracked rocks, and faunal materials, control during excavation of the lower levels was reduced to 10 cm levels and 50 cm by 50 cm horizontal units. Though this was unfortunate, it was recognized that the deposits in this area were clearly differentiated into two vertical concentrations. Completion of this unit offered the opportunity to recover a relatively large sample of materials from two stratigraphically separated depositional units. Since such samples had not previously been recovered in any other area of the site, this compromise seemed justified. In a later section of the report, it is suggested that the information obtained here eventually proved critical in understanding the occupational history of the entire site.

The use of 10 cm arbitrary excavation levels was employed consistently throughout the 1978-1979 seasons. Attempts to excavate with natural levels had proven difficult or impossible in the previous seasons due to an inability to detect very subtle textural and color

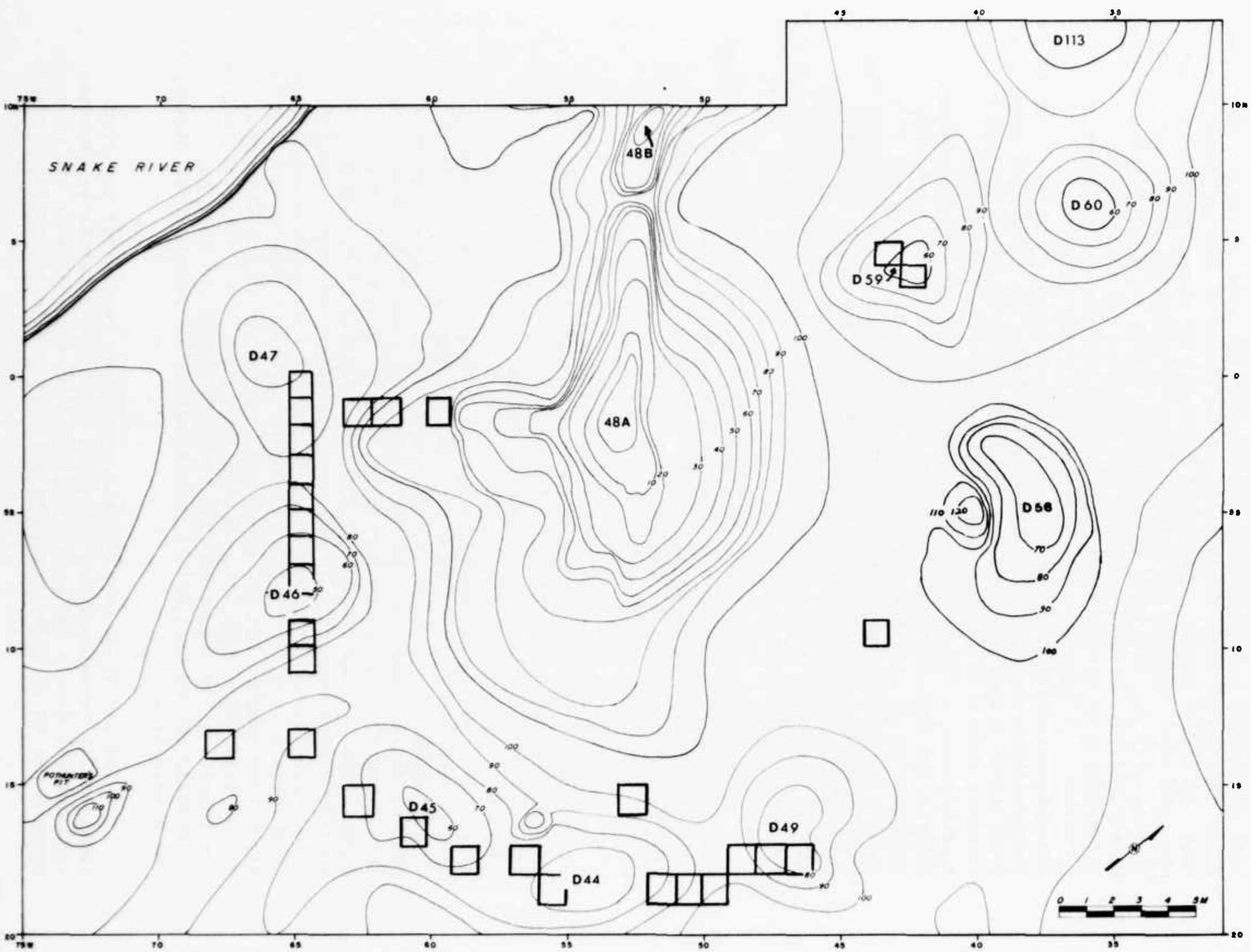


Figure 3-3. Excavation units in Area 500--a coherent and circular arrangement of depressions on the right bank of the island.

differences except in vertical profiles. In retrospect, it seems likely that a combination of shading excavations with tarpaulins and constant wetting of the sediments would probably have improved upon the effectiveness with which natural stratigraphic units could be followed.

To maximize the precision of horizontal controls in the absence of consistent use of three-dimensional proveniences, standard 1 m^2 excavation units were excavated in 50 cm^2 quadrants. Except for fire-cracked rock, all cultural materials recovered in situ or in 1/4 inch mesh screens were bagged by quadrant. Fire-cracked rocks were collected from the OA-78 block excavation but, in all other excavation units, were counted, weighed, and discarded in the field. Fine-screen samples were systematically collected in 1978 and on a judgmental basis in 1979. Most of these samples remain unprocessed.

NOTES

1. Due to some unidentified mapping error, the surface depressions on the master map of the site (see Cleveland 1978; Figure 2) do not correspond well with the grid system across the site in certain areas. Particular discrepancies have been identified in the downstream portion of the right bank housepit cluster.

REFERENCES CITED

Binford, L. R.
1978 Nunamiut Ethnoarchaeology. Academic Press. New York.

Cleveland, Gregory C.
1977 Experimental Replication of Butchered Artiodactyla Bone with Special Reference to Archaeological Features. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village near Burbank, Franklin County, Washington, pp. 30-48. Washington Archaeological Research Center, Washington State University, Project Report No. 46.

1978 Some Inferences about Patterned Behavioral Activities Influencing the Distribution of Artifacts and Their Soil Matrices. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), a Late Prehistoric Village near Burbank, Washington, pp. 31-60. Washington Archaeological Research Center, Washington State University, Project Report No. 72.

Cleveland, Gregory C. (editor)
1978 Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), a Late Prehistoric Village near Burbank, Washington. Washington Archaeological Research Center, Washington State University, Project Report No. 72.

Cleveland, Gregory C., S. Jeffrey Flenniken, David R. Huelsbeck, Robert R. Mierendorf, Stephan Samuels, and Fekri Hassan
1977 Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report No. 46.

Hassan, Fekri
1977 Stratigraphic and Geomorphological Setting of the Miller Site, Strawberry Island, Appendix 2. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village near Burbank, Franklin County, Washington, pp. 143-163. Washington Archaeological Research Center, Washington State University, Project Reports Number 46.

Mierendorf, Robert R.
1977 Sediment Analysis. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report No. 46.

Nelson, Charles M.
1969 The Sunset Creek Site (45KT28) and its Place in Plateau Prehistory. Laboratory of Anthropology, Washington State University, Reports of Investigations 47.

Osborne, Douglas
1957 Excavations in the McNary Reservoir Basin near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Paper 8:1-258.

Osborne, Douglas, and Robert H. Crabtree
1961 Two Sites in the Upper McNary Reservoir. Tebiwa 4(2):19-36.

Shiner, Joel
1961 The McNary Reservoir; A Study in Plateau Archaeology. Bureau of American Ethnology, Bulletin 179, River Basin Surveys 23:259-266. Washington, D.C.

South, Stanley
1979 Method and Theory in Historical Archaeology. Academic Press, New York.

CHAPTER 4

STRATIGRAPHY AT THE MILLER SITE, 45FR5, A PREHISTORIC VILLAGE ON STRAWBERRY ISLAND

by

Robert R. Mierendorf

Introduction

This paper is a study of the sediments and stratigraphic layers from the Miller Site, 45FR5. It is assumed that the stratigraphic context of artifacts and features is closely related to their cultural context. As such, interpretation of the former can be crucial to an understanding of the latter. Archaeologists have long been interested in geological interpretations of sites; this concern is not new. However, this interest has too often resulted in ambiguous descriptions of site sediments:

> No longer is it sufficient to admit that two concentrations of artifacts are separated by a certain thickness of "reddish brown earth," but it is necessary to give specifications on the granolometry, color coding, chemistry, heavy minerals and clay minerals, etc. (Farrand 1980:217).

I agree with Farrand, but I think the point he was making was not completed because once the "necessary specifications are given," their meaning must be stated in simple language void of technical jargon.

Stratigraphic interpretation has a number of broad applications which have been discussed by Gladfelter (1977) and Hassan (1978 and 1979). In this paper the following problems will be addressed:

1. Correlation of stratigraphy throughout the site is based upon field description and mapping of stratigraphic layers exposed in excavation and test units.

2. The depositional history and implications for environmental variability are inferred from evidence obtained through laboratory grain size analysis and historic records of climate and land use.

3. A model of pit feature structure is suggested, and the model's potential application to excavation and interpretation of Plateau pit houses is discussed.

4. Temporal control is provided by the C-14 method.

Background

Geology and Geography

The Miller site lies within the Walla Walla Section of the Columbia Plateau Province (Hunt 1967:351). This section is a structural basin lying between the Cascade Mountains to the west and the Rocky Mountains to the east. In the lowest part of this section, the Pasco Basin, elevations are below 500 feet above sea level. In this basin the Snake River joins the Columbia River. This lower portion of the Snake River is characterized as possessing a broad, flat alluvial valley where Pleistocene and Recent terraces have formed.

Nearly horizontal basalt flows compose the underlying bedrock. These flows emanated from fissures during the Miocene and Pliocene. Within the Pasco Basin, the flows cumulatively exceed 10,000 feet in thickness (Easterbrook and Rahm 1970:110).

Sediments ranging in age from the late Pliocene to Recent overlie basalt in the immediate vicinity of the Miller site. The Ringold Formation is composed of tuffaceous sands, conglomerate, and laminated sands and silts of Pliocene and Pleistocene age. Although outcrops of this formation have not been mapped in the vicinity of Strawberry Island, well drillers' logs indicate subsurface deposits along the Snake River near its mouth (Grolier and Bingham 1978:40). The Palouse Formation consists dominantly of silt-size particles that have been transported and deposited by wind. Initial deposition occurred during the late Pliocene (Gilkeson 1962:1) and continued into Holocene times. These sediments blanket a large portion of the Lower Snake River and its tributary drainage systems.

Glaciofluvial sands and gravels are believed to be the result of late Pleistocene catastrophic flooding. Composition is of steeply cross-bedded gravels, sands, and silts. Remnants of one such bar occupy both banks of the Snake River in the approximate vicinity of Strawberry Island.

Deposits of rhythmically bedded sands, silts and clays along with some gravels and volcanic ashes overlie flood gravels. Such deposits blanket portions of the Pasco and Quincy Basins (Grolier and Bingham 1978). These "Touchet Beds" are poorly understood. They are believed to be related to a "slack-water" or "lacustrine" phase of the same events responsible for the underlying gravel deposits. Carson, McKhann, and Pizey (1978) provide a brief review of the evidence and interpretations.

Sand dunes of Holocene age occupy portions of the Columbia Plateau. One such dune field is located a short distance north of the Snake River in the Pasco Basin (Easterbrook and Rahm 1970:147). Also, frequent localized dunes occur along islands and banks of the Snake and Columbia Rivers.

Holocene alluvial deposits of channel-lag gravel and channel fill silts, sands, and gravels occupy floodplains along the Snake and Columbia Rivers and their tributaries.

Geomorphology of the island has been described by Hassan (1977). I draw largely on his description. Strawberry Island is about 2.74 kilometers

long and 250 meters across (Figure 4-1). The northwestern margin of the island is a channel about 150 meters wide and the southeastern margin is a channel about 375 meters wide. Prior to reservoir formation, the latter possessed two rapids. Rapid No. 22 was located approximately even with the upstream point of the island. Rapid No. 23, Perrine's Defeat, was located approximately midway along the island's length (U.S. Congress 1898:12). Impoundment of water behind McNary Dam has created a permanent channel that diagonally bisects the island. Prior to the reservoir, this channel existed only during high water stages.

The island apparently originated as a gravel deposit in a previously undivided channel at least 2500 years ago. Vertical and lateral accretion of fine sediments deposited during seasonal flood episodes and stabilization by vegetation resulted in subsequent enlargement of the island. As a result, low natural levees occur on both margins of the upstream portion of the island. A beach composed of well-sorted, fine sands borders the island. The width of this beach varies with the level of the reservoir. Twenty or more meters of beach have been observed during low reservoir levels. These beach sediments are subject to wind action and the resulting formation of small dunes. Barchan-like dunes of this type are active on the downstream tip of both segments of the island (Hassan 1977:147).

In addition to the depositional processes discussed above, erosional processes are also important in controlling island morphology. Hassan (1977) points out that channel instability has caused erosion of the island margins. Cleveland et al. (1976:34-36) have noted bank under-cutting due to wave action associated with barge traffic and high reservoir levels. Seasonal floods have eroded low channels across portions of the island (Hassan 1977).

Previous Archaeological Research

In 1951 a small portion of 45FR5 was excavated by a crew from the University of Washington, under the direction of Douglas Osborne. At that time, 131 definite "house pits" were reported visible on the ground surface (Osborne and Crabtree 1961:19). Of these, three were tested by excavating trenches; four were tested by means of a five foot square excavation unit in each. From this they concluded (Osborne and Crabtree 1961:22-26):

1. The site is late prehistoric in age.

2. Two separate culture-bearing strata are represented. An upper unit represents the (house pit) occupation, which is of greater duration than the underlying prehouse pit occupation.

3. All depressions tested resulted from mat houses built over shallow pits; none appeared to the authors to be remains of "true deep pit houses" described ethnographically for the Plateau.

4. Occupation of the house pits was scattered, and "not all or even a large percentage of the pits were dwelling places at one time" (Osborne and Crabtree 1961:26).

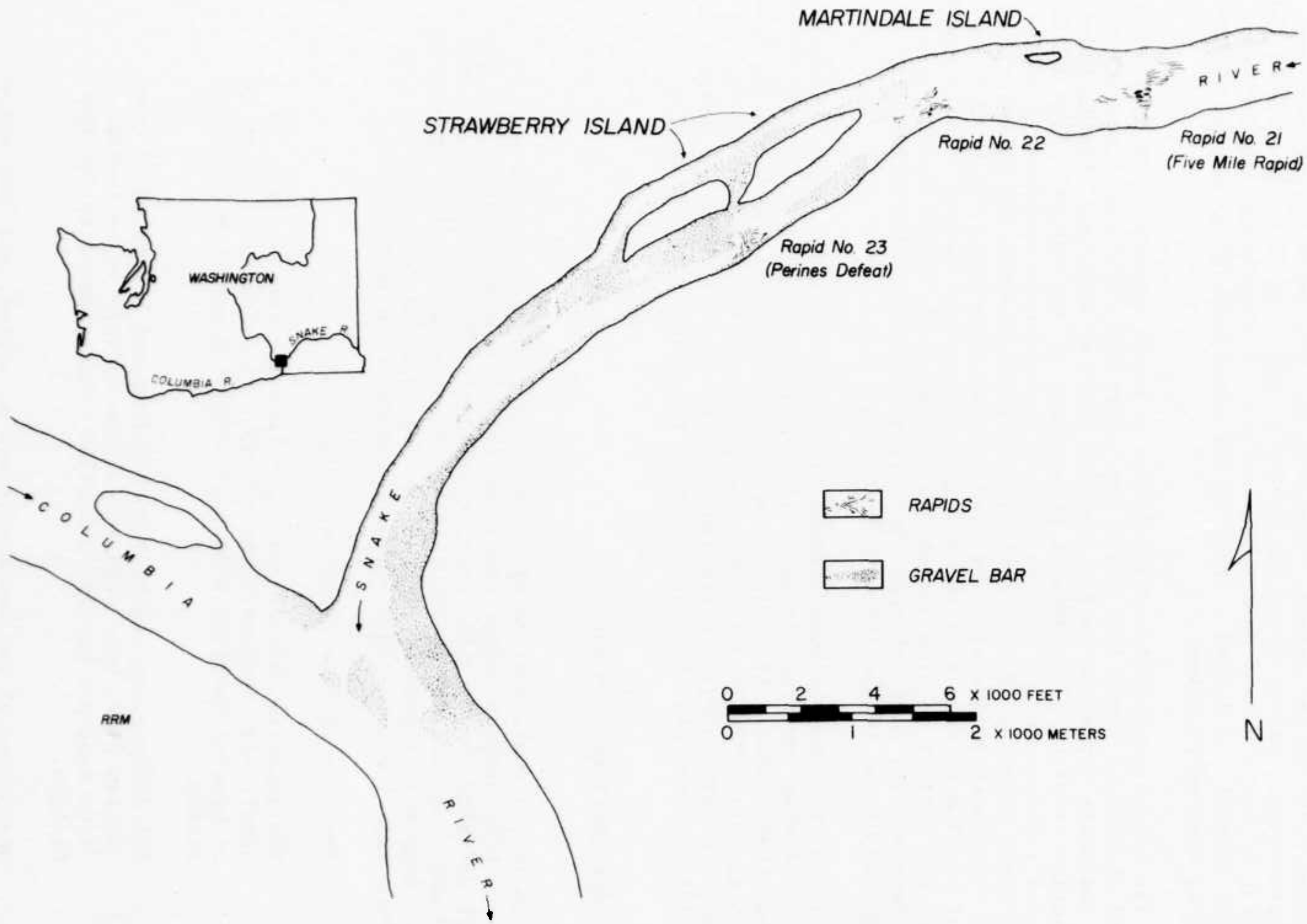


Figure 4-1. Vicinity Map of Strawberry Island and the Mouth of the Snake River Prior to the Creation of McNary Reservoir, Showing the Locations of Rapids and Gravel Bars Exposed During Low Water (adapted by R. R. Mierendorf from U.S. Congress 1898:Plate 4)

Archaeological survey and inventory was conducted in 1975 along portions of the Columbia, Snake, and Palouse Rivers by a crew from the Washington Archaeological Research Center, under the direction of Gregory Cleveland. The Miller Site was briefly visited at that time. It was reported that barge traffic and vandalism by local collectors were disturbing the site (Cleveland et al. 1976:36).

In spring of the following year, the site was more intensively investigated by the same institution. With the aid of photogrammetric techniques, a detailed site map was constructed. Collections were made of cultural materials eroding onto the island beaches. A preliminary faunal analysis was made on the basis of these collections (Harkins, Brown and Gray 1976). Finally, Hassan (1977) wrote a preliminary study of site stratigraphy and geomorphology.

Field Observations and Results

Method

Field observations were recorded of stratigraphy exposed during excavation and along natural erosional exposures. These observations have been organized into profile descriptions and profile diagrams.

With some modifications the profile descriptions conform to conventions expressed in the Revised Soil Survey Manual of the Soil Survey Staff (1975). Properties described include pedological structure, consistence at various moisture states, horizon boundaries, color, root distribution, and textural class. Field determinations of the latter generally follow criteria provided by Foss, Wright, and Coles (1975). Sediment color is recorded according to conventional usage of the Munsell Soil Color Charts. Properties described for sedimentary structures and bedforms are consistent with the usage of Reineck and Singh (1973). Cultural materials observed in profile are considered properties of the profile; however, nontechnical language is used for description. Profile descriptions appear in Appendix A.

Profile diagrams record textural classes, boundaries of stratigraphic units, cultural remains, and C-14 dated material plotted against island provenience (elevation in meters above sea level vertically; a metric Cartesian coordinate system horizontally). For diagrammatic purposes, sediments are classified into five textural classes: gravel, sand, sandy loam, silt loam, and silt. These classes span the range of observed profile sediments. At the right hand margin of each profile diagram stratigraphic units are labeled as they appear in the profile descriptions. For the purposes of this report, only a few representative profile diagrams appear in the text (see also Appendix C).

To avoid confusion it will be helpful to clarify the usage of some commonly used terms. Throughout this paper, a distinction is made between depressions, excavation units, and pits. The one property these three terms have in common is that they are or once were, holes in the ground. Depressions are shallow, concave irregularities of the present ground surface. They may or may not be aboriginal in origin, although Plateau archaeologists often mistakenly assume that all depressions are the remains of aboriginal houses. Excavation units, on the other hand, are square holes dug by archaeologists.

Finally, pits are aboriginally excavated features which have to some degree been filled in with sediments. They are observed most frequently in the walls or floors of excavation units. Some examples are housepits, storage pits, food processing pits, and hide-smoking pits. Sometimes, depressions mark the location of pits.

Sampling

Most of the profile descriptions and profile diagrams recorded in this report were exposed in the walls of excavation units. This sample of profiles is thus representative of archaeological problems addressed by the research design, which in turn reflects contract obligations. The following method was used to sample island depressions. The universe of recorded depressions on the island was stratified according to three criteria: apparent clusters, shape, and size. Depressions cluster quite clearly into one group located on the southeast shore of the island and another group on the northwest shore. According to the second criterion, all depressions were categorized as either round or elliptical. Finally, depressions were classed into those between 1 and 3.5 meters in diameter, those between 3.5 and 6 meters, and those larger than 6 meters. Depressions were then randomly selected from within each of the twelve groups generated by the three criteria. Only one of the depressions thus selected was not tested; and therefore, lacks stratigraphic information. Most, but not all walls of excavation units were recorded stratigraphically.

In addition to this sample, some profiles were selected for their relevance to stratigraphic problems. These included profiles exposed naturally as a result of bank erosion and profiles from the locality surrounding the site. This latter group is necessary because site stratigraphy is understandable only in the context of the more general processes conditioning stratigraphic variation within the locality or region, and therefore provides a basis for distinguishing cultural from natural causes of stratigraphic variability.

Description of Strata

The sediments from the Miller Site are organized into four descriptive groups, each termed a stratum. These are designated with Roman numerals. Stratum I begins at the present ground surface and Stratum IV is the lowermost sediment thus far observed (Figure 4-2). Subdivisions within strata are called units, which are designated with lower alphabetic letters.

It should be noted that the finest degree of sediment variability recorded in the profile descriptions conforms to the level of a unit.

Strata I through IV are briefly characterized below according to the properties of color, texture, pedological and sedimentological structure, vertical and horizontal variability, boundaries, and cultural remains.

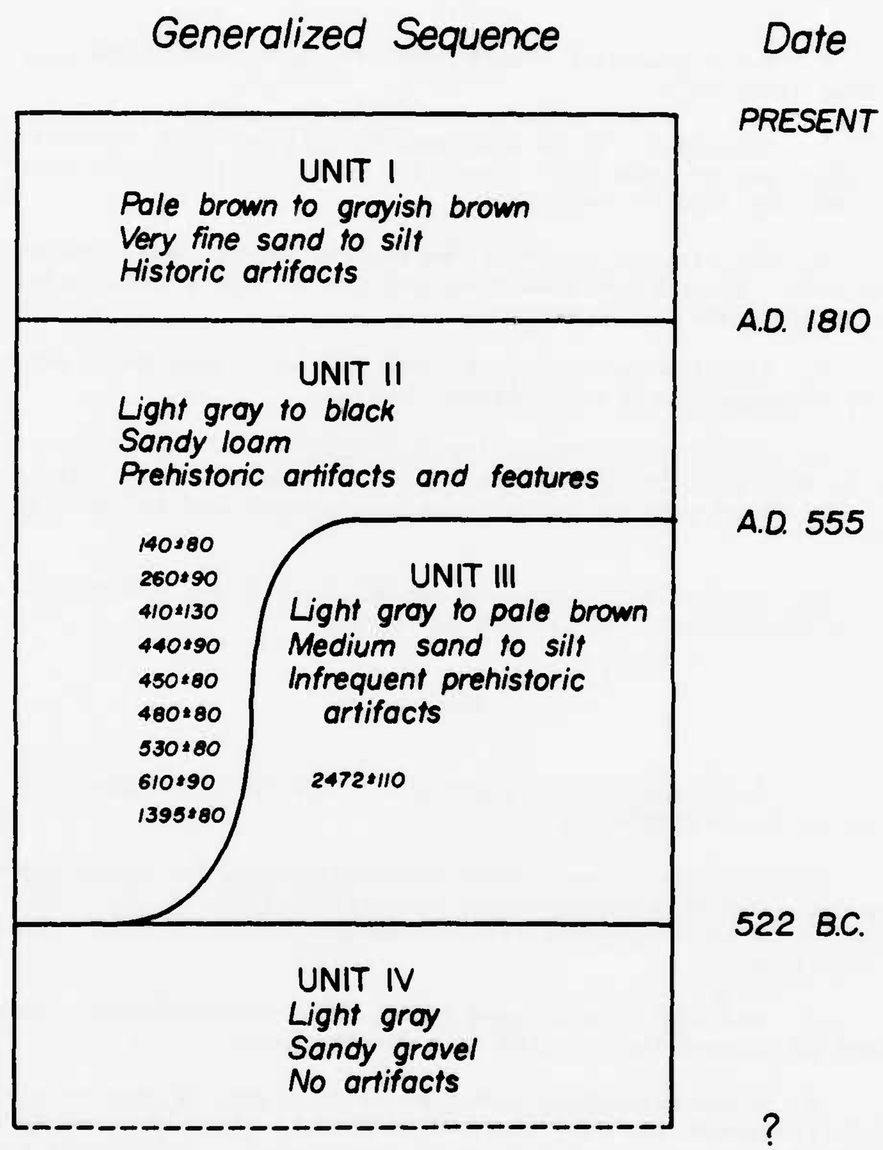


Figure 4-2. Schematic Diagram of the Sequence and Chronology of Stratigraphic Units at the Miller Site, 45FR5

Stratum I

1. Color (air dry) ranges from very pale brown (10YR 7/3) to grayish brown (10YR 5/2).

2. Texturally, it is dominated by silt and silt loam units, of which there are at least two. These are separated by coarser units that vary from fine sand to sandy loam.

3. The stratum begins at the present surface and contains the modern soil. Pedological structure consists of weakly developed, very fine granules and plates.

4. In a few instances, the sand and sandy loam units exhibit moderately expressed, thin cross-bedded laminae.

5. Depth varies from a few centimeters near the center of the island, to more than 50 centimeters along the natural levees. The lowermost silt unit of the stratum can be correlated across most portions of the island.

6. No aboriginal cultural remains have been found in situ; artifacts of Euro-American occupation are present.

Stratum II

1. Color varies from light gray (10YR 7/2d) to pale brown (10YR 6/2.5d) to black (10YR 2/1d).

2. It is more homogeneous texturally than the strata above and below, being dominated by a uniform sandy loam textural class with only localized, discontinuous and frequently irregular-shaped lenses of finer texture (silts and silt loams).

3. Pedological structure varies from massive in most cases to single-grained (a structureless state) in a few instances.

4. Sedimentological structure is described as massive since no internal arrangement has been observed macroscopically. Such sediments frequently require special techniques to make internal arrangement visible; (see Reineck and Singh 1973:112 or Pettijohn 1975:104). Near the contact with Stratum I, faint, weakly expressed, thin, wavy lenticles of silt loam are observed parallel to the Strata I/II contact.

5. The stratum varies between 60 centimeters and 110 centimeters or more in thickness. Over lateral distances of a few meters a wide range of thicknesses are observed due to Stratum II pits which intrude into Stratum III. The stratum appears to be continuous across all portions of the site.

6. An abrupt boundary is formed in some instances with Stratum III or Stratum IV where Stratum III has been removed by cultural processes.

7. Most characteristic is the presence of localized high densities of aboriginal cultural remains, such as fire-broken rocks, rounded river pebbles and cobbles, fish bones, split mammal bones, bone tools, and chipped and ground stone tools and debitage. These are frequently associated with variable densities of organic stains and charcoal concentrations.

Stratum III

1. Overall, Stratum III dry color varies between light gray (10YR 7/1d), gray (10YR 6/1d), very pale brown (10YR 7/3d) and pale brown (10YR 6/3d). Some units are mottled pinkish gray (7.5YR 7/2d) to reddish yellow (7.5YR 7/6d). Infrequent concentrations of charcoal are very dark gray (10YR 3/1d) to black (10YR 2/1d to N 2/0).

2. Most characteristic is the interbedding of high sand content beds (medium to fine sands and sandy loams) with high silt content beds (silts, silt loams, loamy sands, and very fine sandy loams). In situ, these textural differences are made quite prominent due to a capillary fringe acting upon the differential moisture-holding capacity of the various beds; thus, the silty units are frequently moist while the intercalating sandy units are dry. These differing moisture states are easily visible in profile.

3. The uppermost silt unit of Stratum III, along with weak, angular blocky structure, has the properties of slightly higher plasticity and stickiness, and faint oxidation mottles of slightly higher chroma than the surrounding matrix. From this evidence, weak development of a structural B horizon may be inferred. Most other Stratum III units are massive to single-grained.

4. The sedimentary units within Stratum III vary from tabular to lenticular in form. In most cases, the structure within units appears massive, but in one case weakly expressed, very thin cross-bedded laminae were observed. These laminae are composed of oriented mica flakes and possess a slightly higher silt content than the enclosing matrix.

5. Depth varies from 20 centimeters near the center of the island to 90 centimeters along the margins. The stratum is correlative across the island; however, the degree of interbedding is greatest near the island margins and decreases toward the center.

6. Aboriginal cultural remains are present but sparse. One localized concentration of cultural remains was recorded in situ resting on the Strata III/IV contact. It consisted of fire-broken rocks, siliceous flakes, cobble tools, a basalt scraper, shell fragments, a bone splinter, and three projectile points.

7. An abrupt, smooth to wavy boundary is formed with Stratum IV.

Stratum IV

1. Color is variable and difficult to characterize due to the gravelly nature of this stratum. Granitic and quartzitic clasts vary from gray to white, while those of basaltic origin are dark gray. Precipitates are visible as white (10YR 8/1d) coatings on the bottom sides of clasts. A loose fine sand comprises the interstitial matrix.

2. The stratum is dominated texturally by gravels which are mostly well-rounded spheroidal and disk-shaped.

3. No internal stratification of the stratum has been observed. In most exposures, the gravels are imbricated.

4. The depth of the stratum remains unknown. Laterally, it appears to underlie all portions of the subaerial part of the island. Exposure is limited in most locations by the high water table.

5. No cultural materials have been found within this stratum.

Chronology and Origin of Strata

Stratum I

This stratum was recognized as being historic in age in an exposure along the northeast erosional bank of the island (Mierendorf 1977:111-112). At this location, three heavily rusted iron straps were observed and recorded *in situ*. They measured approximately 55 centimeters in diameter and clearly rested on the contact between Strata I and II, within the lowermost Stratum I silt. There was no evidence of disturbance or intrusion through the overlying portion of Stratum I. It is probable that these bands were used to hold together the staves of a wooden barrel.

The sediment surrounding these hoops correlates with the lowermost silt unit of Stratum I and can be traced laterally across the upper half of Strawberry Island. Granulometric analysis of two samples indicated approximately 75 percent silt, 20 percent sand, and 5 percent clay. The dominance of silt, the compactness of the unit, its greater thickness in the bottom of basins, and the erosional character of the Strata I/II contact can be used to infer high flood waters carrying a high sediment load with deposition occurring in a flood basin environment.

It is difficult to correlate specific silt units with historical events, however, historical records can provide useful information. The largest floods, in descending order as measured by peak discharge at the Dalles, occurred in 1894, 1948, 1876, and 1956 (U.S. Army Engineer Division 1969:9). Research has shown that prior to the destruction of native vegetation with the establishment of an agricultural economy, little or no erosion occurred during high seasonal floods and flood waters were almost silt free (Victor 1935:19; Kaiser 1961:139). In fact, Kaiser reports:

> Two of the most severe floods ever recorded in Whitman County occurred in 1894 and 1910. Although considerable water damage was done to urban property in Pullman and Colfax, there is no good record of siltation damage in 1894 and only slight siltation accompanied the 1910 flood (Kaiser 1961:141).

Kaiser goes on to state that severe, annual soil erosion in the Palouse did not begin until the late 1920's and early 1930's. The above references to erosion apply to the Palouse region of southeastern Washington and adjacent portions of Idaho and Oregon. This area comprises only a portion of the entire area drained by the Snake River, however. If we consider the Palouse region to be drained by tributaries of the Snake River between its mouth and the Grand Ronde River and its drainage area, then 18.3 percent of the total Snake River drainage area is represented (percentage computed from data shown in U.S. Congress 1933:116-118, Table 2). It is probable that this region contributes a disproportionately large share of sediment to the Snake River relative to its total drainage area.

Boucher (1970) studied sediment transport in streams of the Palouse. He found that in the Palouse River Basin, the area of loess-covered hills contributed the greatest amount of sediment per unit of area. The scablands area, with its low rainfall and thin soil, contributed the least amount of sediment to rivers. The eastern margin of the Palouse region with its higher density of vegetation, higher rainfall, and only thin loessial soils, contributed less sediment to streams than the area of deep loessial cover.

Boucher shows that years of heavy precipitation not necessarily correlate with high sediment discharge (Boucher 1970:C34). Rather, the following seems to be the case:

> A major part of the annual sediment discharge is transported when events occur in the following sequence: (1) low temperatures freeze the soil, (2) snow falls on top of the frozen ground, and (3) an abrupt rise in temperature occurs and, accompanied by warm rains, melts the snow and partially thaws the soil. This sudden increase in liquid moisture on top of ground frozen below a shallow depth causes a sudden increase in runoff, erosion of the top few inches of the thawed soil, and consequent high sediment discharge in streams (Boucher 1970:C31).

Both Boucher (1970), and Mapes (1969) in a similar study in the Walla Walla River Basin, report that silt is the dominant suspended sediment transported by all streams within their respective study basins.

The sequence of climatic events quoted above corresponds closely with meteorological records prior to and during the flood of 1948 (U.S. Geological Survey 1949; U.S. Army Corps of Engineers 1949). Mid-April to mid-May of that year was a period of above-normal precipitation with below-normal temperatures, resulting in buildup of snowpack. In contrast, mid-May to mid-June was characterized by above-normal precipitation and temperatures. Extremely high runoff resulted from rain falling on a thawing winter snowpack. Modifications of the landscape as a result of the flood were severe and widespread:

> . . . 4,250 acres of land lost through stream-bank erosion, and an additional 19,000 acres damaged by deposition; and 161 million tons of top soil washed away. As an indication of the extent of movement of silt and debris, the flood deposited about 120,000 cubic yards of sand, silt, and rock in the Dalles-Celilo Canal (U.S. Geological Survey 1949:14).

From this evidence it seems most probable that the lowermost silt unit of Stratum I is derived from the flood of 1948. (It must be kept in mind, though, that the 1894 flood preceded the period of detailed recording of rainfall, temperature, stream discharge, and other flood-associated variables.) As noted in the description of strata, a second silt unit overlies the inferred 1948 unit. This second unit is discontinuous, thin, and not widespread. It is possible that such a unit was deposited during the flood of 1956. It does not seem likely that this silt represents another surge of the 1948 flood due to the fact that within the sandy unit which separates the two silts can be observed many very thin horizontal laminae of organic matter; in some cases these are the charred remains of annual plant stems and leaves. These may represent ephemeral ground surfaces which resulted from wind reworking of flood basin silts with riverine sands near the island banks. The source of these charred plant remains is unknown; however, it is known that the Department of the Interior burned surface vegetation on the island in order to destroy predator habitat during the early 1950s (Cleveland et al. 1977:7).

Concern with historic floods has widespread significance for archaeology of the southern Plateau. Sedimentary deposits attributed to the 1894 and 1948 floods have been recognized or alluded to by numerous archaeologists working in the lower Columbia and Snake River drainages (Swanson 1958, 1960, 1962; Osborne 1957; Stallard 1957; Fryxell and Daugherty 1963; Holmes 1966; Shiner 1961; Cole 1965 and 1968; Daugherty, Purdy, and Fryxell 1967; Grabert 1968; Nelson 1969; Chance et al. 1978; and Dohm 1978). Krieger (1928) noted the effects of flood waters at the Wahluke Site from the deposition of driftwood. Shiner (1961) claimed that erosional activity associated with the 1948 flood had removed evidence of three or four house pits from Berrian's Island.

U.S. Army Corps of Engineers studies (U.S. Army Engineer Division 1969:9) have estimated that a flood equal in magnitude to that which occurred in 1894 has an Average Recurrence Interval of 100 years. If this statistic even approximates reality, then it is entirely probable that hundreds of such floods have occurred during prehistoric times. However, Plateau archaeologists have yet to investigate and evaluate the significance of such phenomena in terms of aboriginal settlement patterns, destruction of the archaeologicl record, and the techniques used to detect archaeological sites (Hammatt 1977 is an exception).

Finally, Stratum I contains the modern soil. The upper 5 to 10 centimeters consists of an Ah horizon which is weakly expressed. Units below this horizon would likely be labeled C horizons, meaning that their observed properties differ minimally from the inferred properties of the parent material. Generally, this is true for most subsurface stratigraphic units of the island.

Stratum II

Nine C-14 samples of charcoal from Stratum II have been dated. These are listed in Table 4-1.

Table 4-1. C-14 Dates from Stratum II*

Dating Lab #	Area	Excavation Unit	Elevation	Date
WSU-1698	D96	58-60S/64-66E	104.21-104.34	610±90
WSU-1699	D119	32-34S/78-80E	104.40	530±80
WSU-1889	D119	36.23S/75.44E	104.98	140±80
WSU-1890	D96	56.80S/61.60E	104.99	450±80
WSU-1891	D76	64-66N/8-10W	105.53-105.57	480±80
WSU-1892	Area 200	73.70N/5.10E	105.20	260±90
WSU-1893	D76	64.35N/7.30W	104.98	410±130
WSU-1894	D96 House 2	52-54S/60-62E	104.29-104.54	440±90
WSU-2241	D9	118-118.25S/149-149.25W	104.30-104.41	1395±80

*Computed with a 5570 year half-life

The contact between Strata I and II appears to be erosional. This accounts for the irregular and undulating character of the contact. One profile exhibits very thin laminae of silt in the extreme upper portion of Stratum II. The laminae are oriented parallel with the undulations of the contact. Such structures are the result of erosion and mixing of the uppermost strata from turbidity currents associated with surges of flood waters. The degree of erosion does not seem to have been great. During excavation, portions of the Strata I/II contact exhibited an observable but slight lag concentrate of heavier cultural material, such as fire-broken rocks and cobble tools. If the 1948 flood interpretation is correct, and if the 140±80 B.P. date is representative of the last aboriginal occupation of the island, then this erosional hiatus represents about 170 years.

More severe erosion has been reported at other Plateau archaeological sites. Along the Columbia River below Wallula Gap, Osborne (1957) and Shiner (1961) found that the 1948 flood removed the surface evidence of entire house pits. Grabert (1968) described heavy erosion in the Okanogan region caused by the 1948 flood. In the Methow Valley, Swanson saw evidence of the 1948 flood having removed a number of complete sites and large sections of floodplains and older terraces (Swanson 1960:72).

Due to post-depositional disturbances, the natural conditions controlling deposition of Stratum II are obscure. There is clear evidence that three types of disturbance processes have contributed to sediment mixing:

1. Burrowing by rodents is apparent from the many krotovinas and the remains of rodent skeletons.

2. Root systems and root casts of plants, especially of big sagebrush and giant wild rye permeate most parts of the stratum.

3. The ubiquity of aboriginal artifacts and features, and large charcoal stains is evidence for intense cultural activity.

Stratigraphically, the most prominent characteristic of Stratum II is the occurrence of pits. These aboriginally excavated features are recognized by the fact that they truncate underlying stratigraphic units and have a distinct cultural content, color, and grain-size distribution compared with the surrounding sediment matrix. Size and shape are extremely variable. For example, the pit exposed in the east wall of the D-114 test trench (Figure 4-3) measured about 1 m in diameter and was excavated about 40 centimeters below the surface that existed at the time of its construction. It is steep-sided and deep relative to its width. Because this pit truncated the Stratum III units abruptly, the boundary is distinct. Prior to excavation, there was no surface indication that this pit existed.

In contrast, the pit exposed at D-128 (Figure 4-4) is approximately four meters in diameter and about thirty centimeters deep. It is relatively shallow with gently sloping walls so that it looks "saucer-shaped" in profile. The pit truncates Stratum III gradually, resulting in indistinct boundaries and greater measurement error. A surface depression marked the location of this pit.

Regularities were observed in the stratigraphy associated with pit features at the site. This structure is divided into two parts. The first of these is termed the "ring zone." This refers to the area outside of but adjacent to the pit boundaries. This zone is essentially a volume filled with sediments, artifacts and other materials associated with the construction and use of a pit (Figure 4-5). The bottom of this zone is the ground surface which existed at the time the pit was dug. The inside boundary is the pit wall. The upper surface and lateral edges are variable. Such a ring zone may be recognized by the occurrence of reverse stratigraphy, i.e., lower strata have been displaced above previously overlying strata. On the Plateau, this zone is recognized at archaeological sites by a high density of fire-broken rocks, river pebbles and cobbles, cobble tools, disarticulated bones, and shells. This distribution has been labeled previously as the "midden ring" (Cleveland 1978:34-35) and the "dough-nut effect" (Holmes 1966:100; Brauner 1976:42). These terms have been used in describing artifact distributions surrounding presumed housepits. However, other functional pit types, such as an earth oven or storage pit, may possess this same structure.

The second region of pit structure is termed the "use zone." Spatially this is the area surrounded by the ring zone; it usually forms a pit or shallow depression in the ground. Internal stratigraphy varies from homogeneous to well-stratified. In the latter case such stratification appears as superimposed lenses of organic stains that range from diffuse gray mottles to distinct black layers, or the layers are in some cases composed of artifactual remains. In profile, these lenses are concave up; a gentle curve is continuous from the floor up through the sides. Such lenses, here called "use levels," are common in Plateau archaeological sites, and when found within housepits, archaeologists have descriptively used the terms "dish-shaped," "saucer-shaped," and "basin-

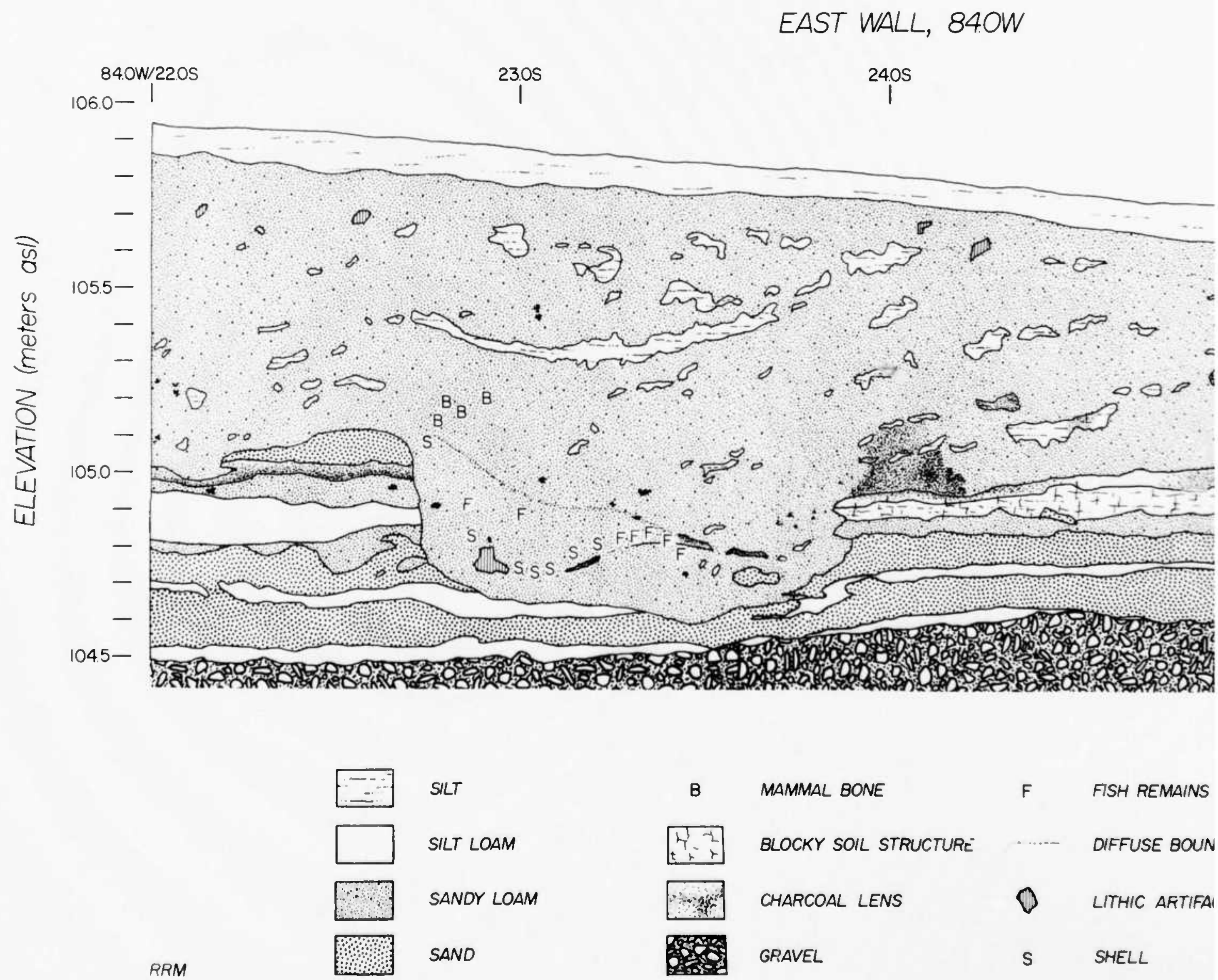


Figure 4-3. Profile Diagram of the East and So
Test Trench Through Depression 114
Abrupt Walled Pit Features

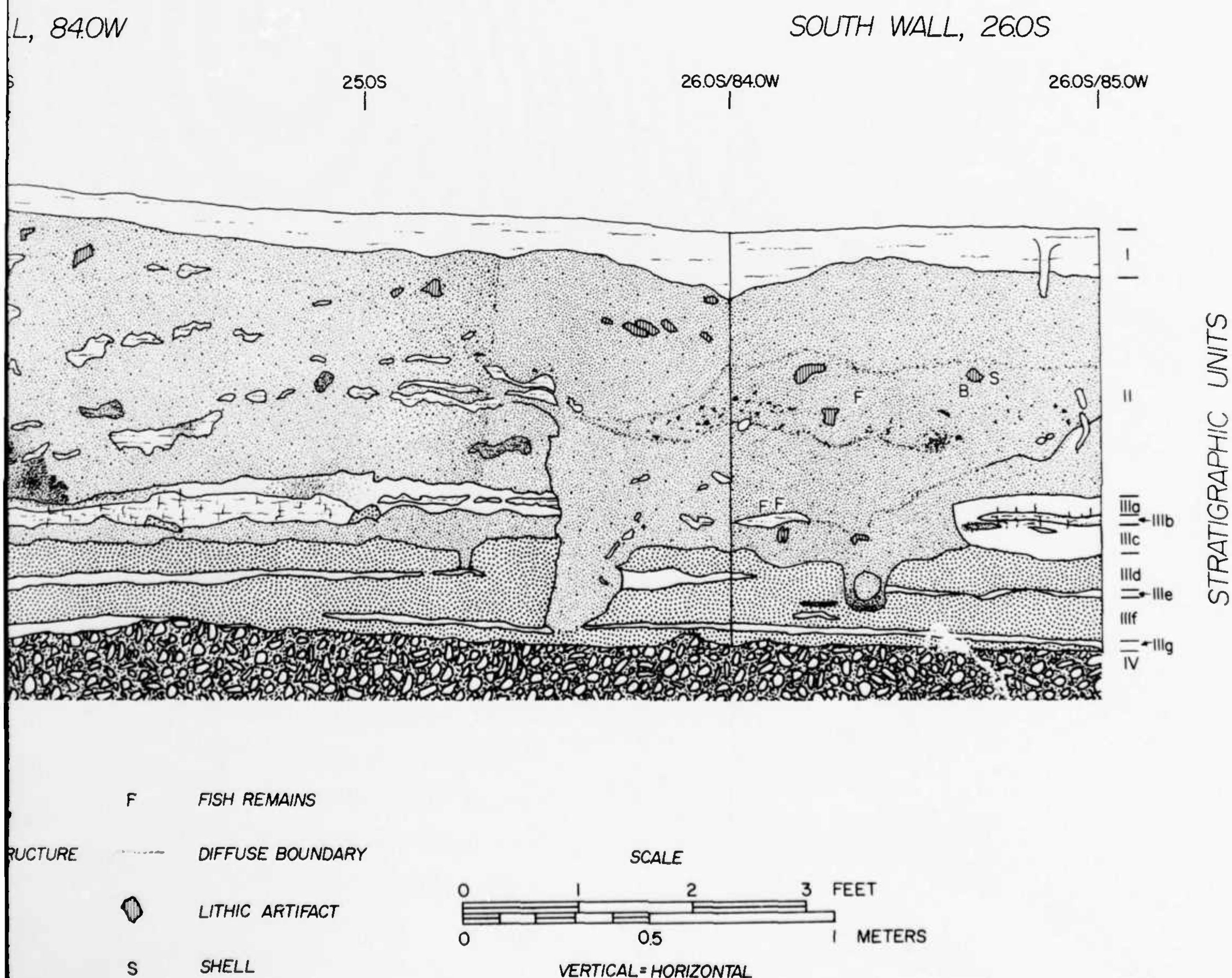


Diagram of the East and South Walls of the
ench Through Depression 114 Showing Two Steep,
Walled Pit Features

2

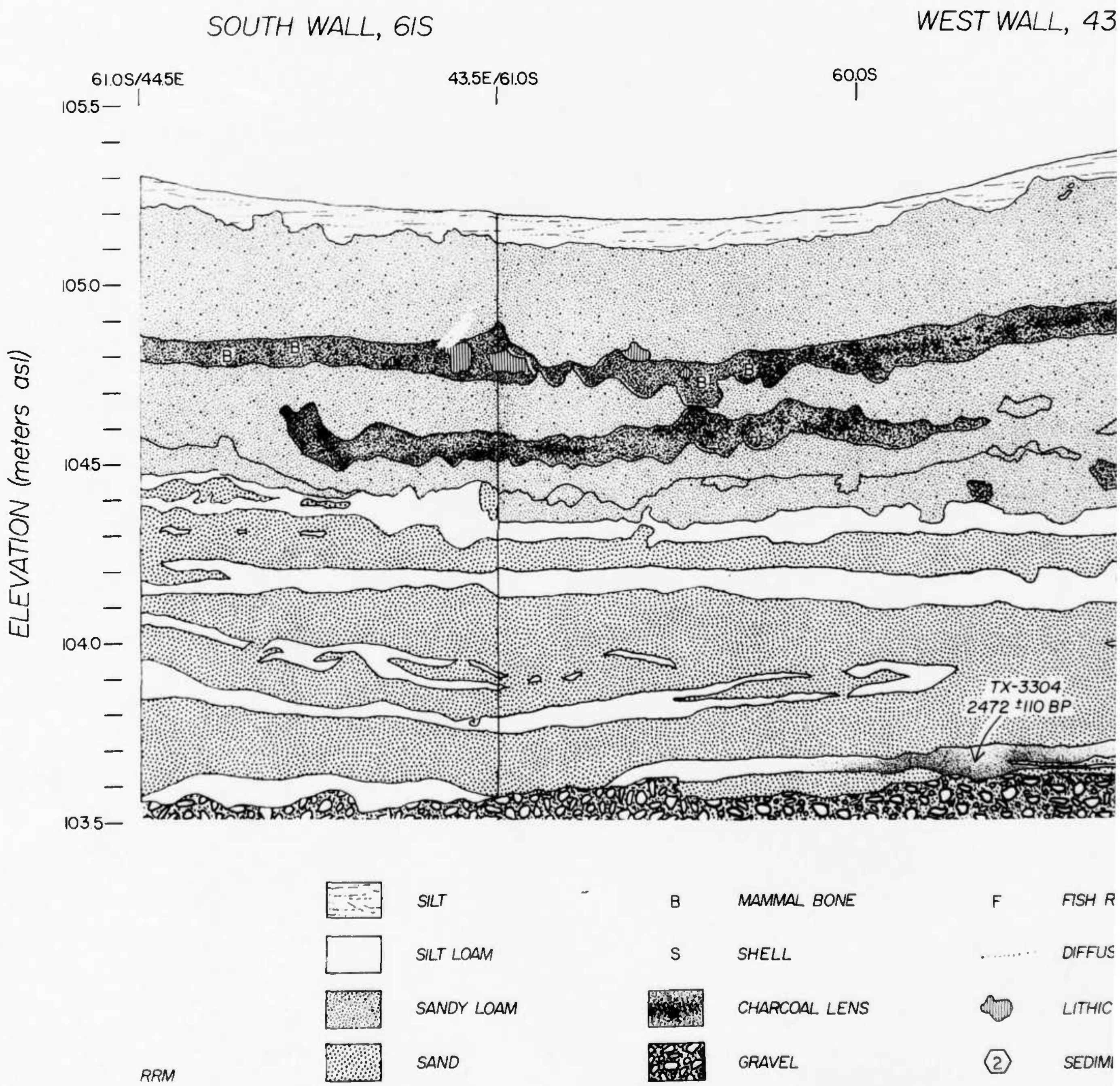


Figure 4-4. Profile Diagram of the South, of the Test Trench Through Dep One Side of a Pit Feature with Wall

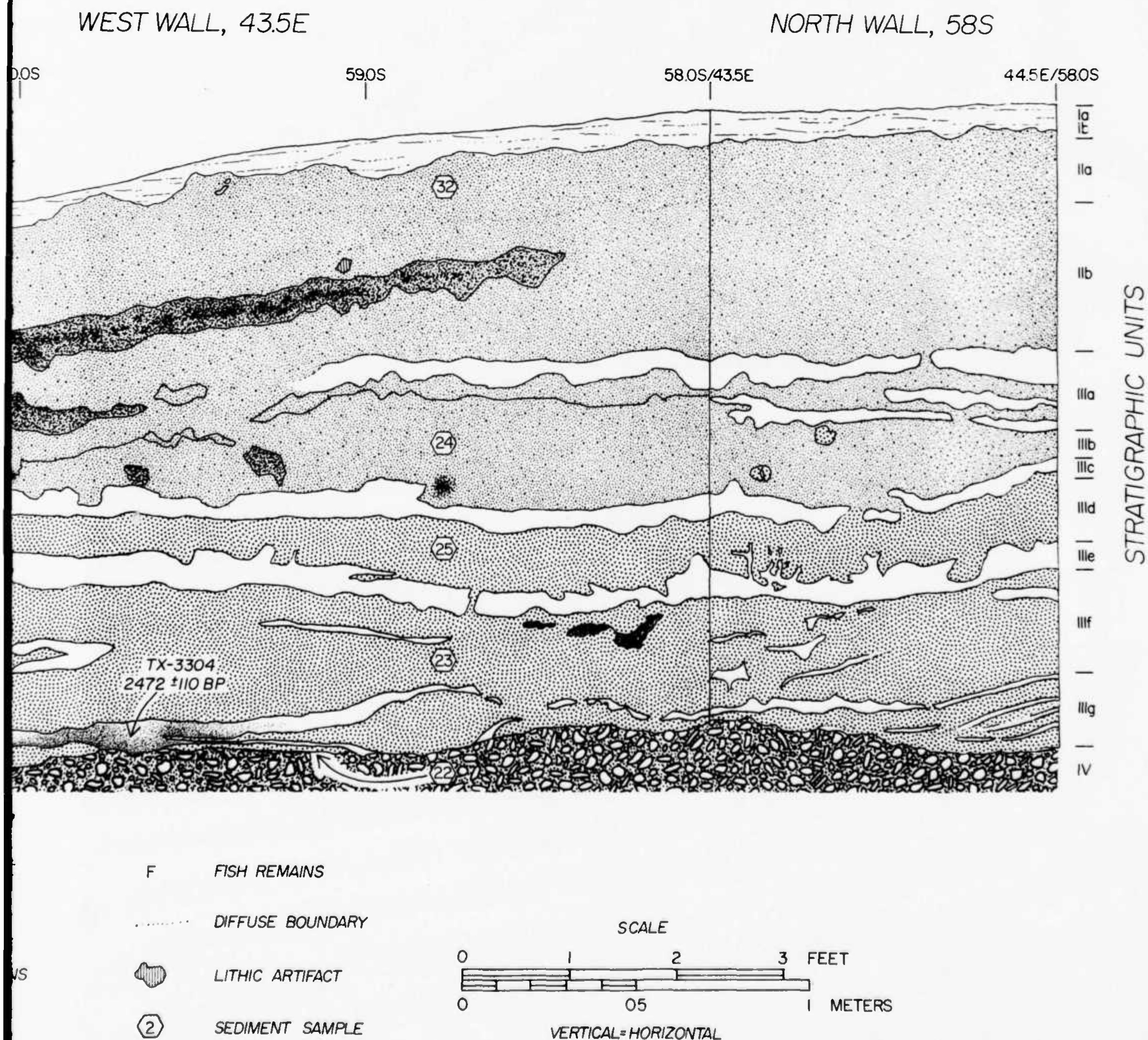


Diagram of the South, West, and North Walls
Test Trench Through Depression 128 Showing
e of a Pit Feature with a Gradually Sloping

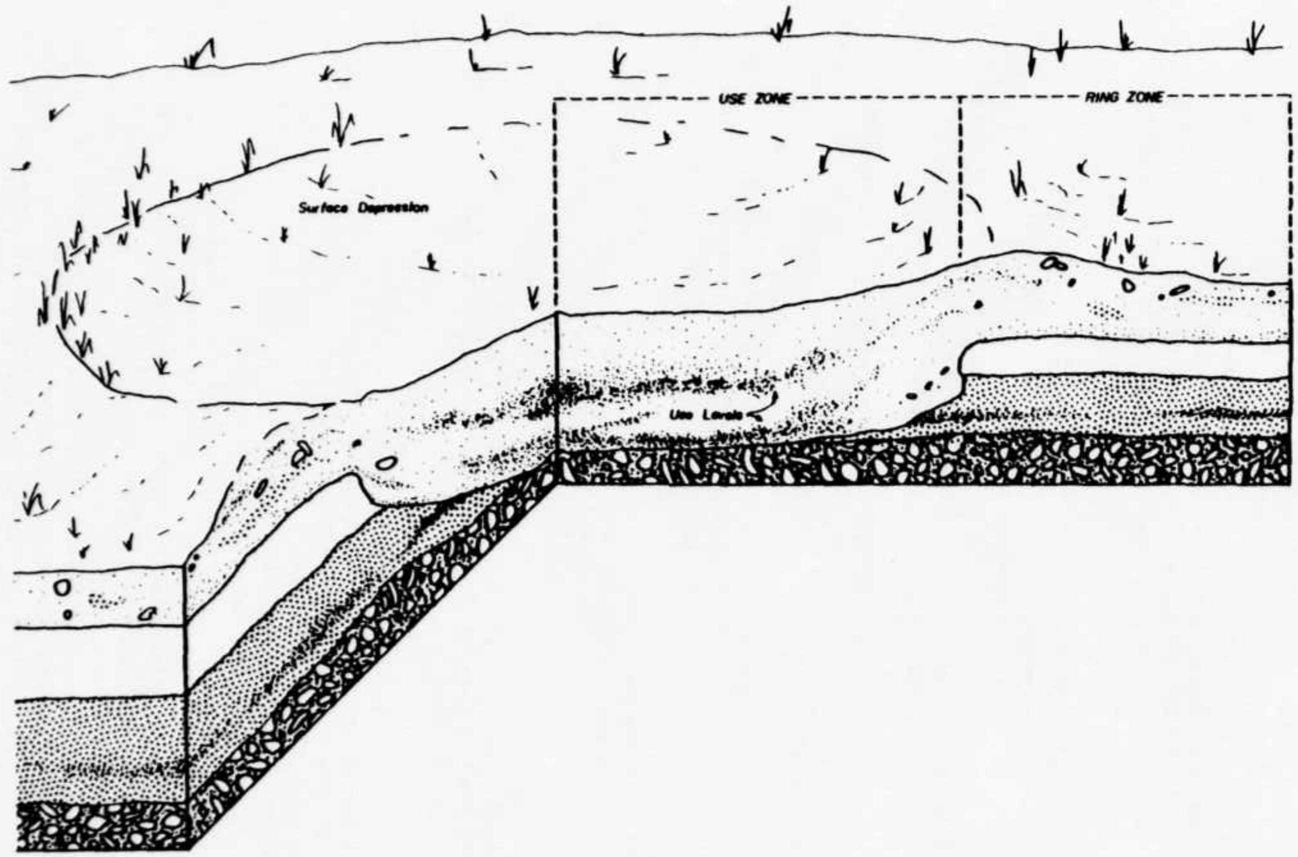


Figure 4-5. Generalized Diagram of a Sectional View of Pit Structure

shaped" (Strong, Schenck, and Steward 1930; Shiner 1952; Daugherty 1952; Osborne, Crabtree, and Bryan 1952; Cressman 1956; Osborne 1957; Shiner 1961; Osborne and Crabtree 1961; Mitchell 1963; Holmes 1966; Caldwell and Mallory 1967; Grabert 1968; Cole 1968; Warren 1968; Nelson 1969; Sanger 1970; Leonhardy et al. 1971; McCoy 1971; Stryd 1972; Turnbull 1973; Whitlam 1976; Chance et al. 1977; Cleveland 1978; and Ames and Green 1979). The meaning of these is uncertain, but it has been stated or implied that each lens represents a single or several season's occupation (Strong, Schenck, and Steward 1930; Shiner 1952; Osborne, Crabtree, and Bryan 1952; Osborne 1957; and Chance et al. 1977).

Intrasite differences in use zone stratigraphy were noted. The number of use levels ranged from none to five. The southeast cluster of depressions revealed, on the average, more use levels per pit than the northwest cluster. In addition, the use levels from the southeast cluster were thicker and much more prominent. Use levels from the northwest cluster were usually thin and diffuse, and therefore, difficult to detect.

Every depression on the island tested to date proved to be associated with at least one or more pits, except for D-56. In a later section, the archaeological and behavioral implication of pit structure will be discussed.

Another type of stratigraphic variability within Stratum II may be associated with cultural activity. This variability consists of a number of silt-rich lenses which are visible as slightly lighter (higher value) mottles within the sandy loam matrix. In profile these lenses appear randomly distributed over short lateral distances, but over distances of several meters a pattern emerges. This is expressed in the profile from D-30 (Figure 4-6). In the walls of this trench, two and possibly three discontinous silt bands are visible. The uppermost is irregular and difficult to follow. Succeeding lower lenses are more distinct due to their greater thickness and continuity. In some stratigraphic profiles from the site, these bands grade into and form a more or less continuous line with the dark curvilinear lenses within the use zone.

The origin of these silt bands is unknown. They may have been deposited by flood waters between seasonal occupations of the site. Subsequent re-use of the pit would have obliterated any deposits within the use zone. If this explanation is correct, it would be expected that similar but more continuous silt bands should be visible at similar geomorphic locations at approximately the same elevations on unoccupied portions of Strawberry Island. Stratigraphic profiles were described at such locations (Profile Descriptions 9 and 10, Appendix A). These are both located along the low levees bordering the island, as are most of the test excavation profiles having the silt bands. In the process of describing these profiles, no cultural remains were observed on the adjacent beach, on the ground surface, or in the subsurface sediments. No discontinuous or continuous silt bands were observed in those portions of the profiles that correlate with Stratum II of the site. Neither was there evidence of the diffuse or concentrated lenses of charcoal in the sandy loam matrix which characterized Stratum II.

The tentative conclusion is that these silt bands of Stratum II are not the result of periodic flooding. Since they seem to occur only in association with pit features at 45FR5, their origin may be related to cultural activity. One possibility is that they are remnants of Stratum III silts that

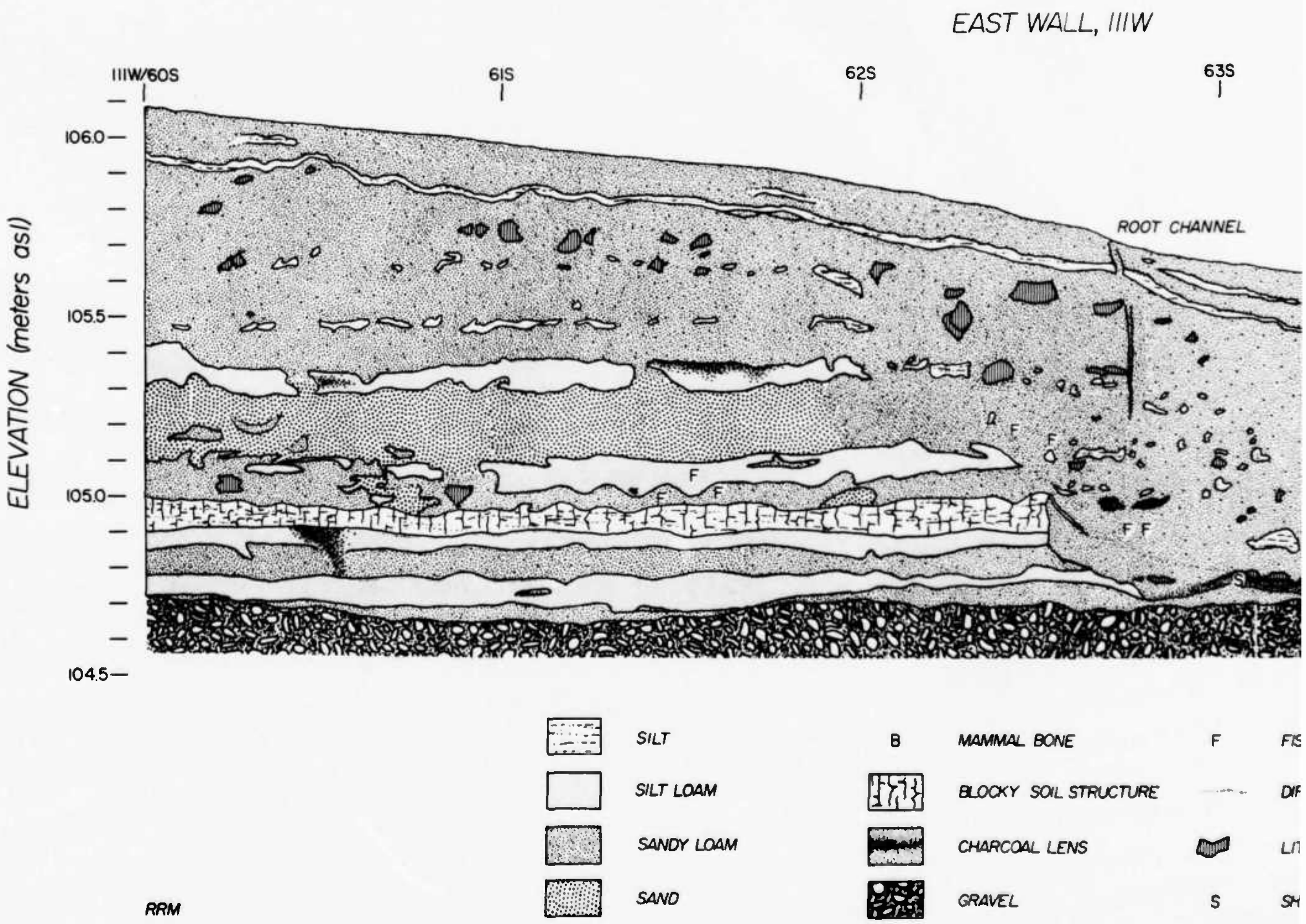
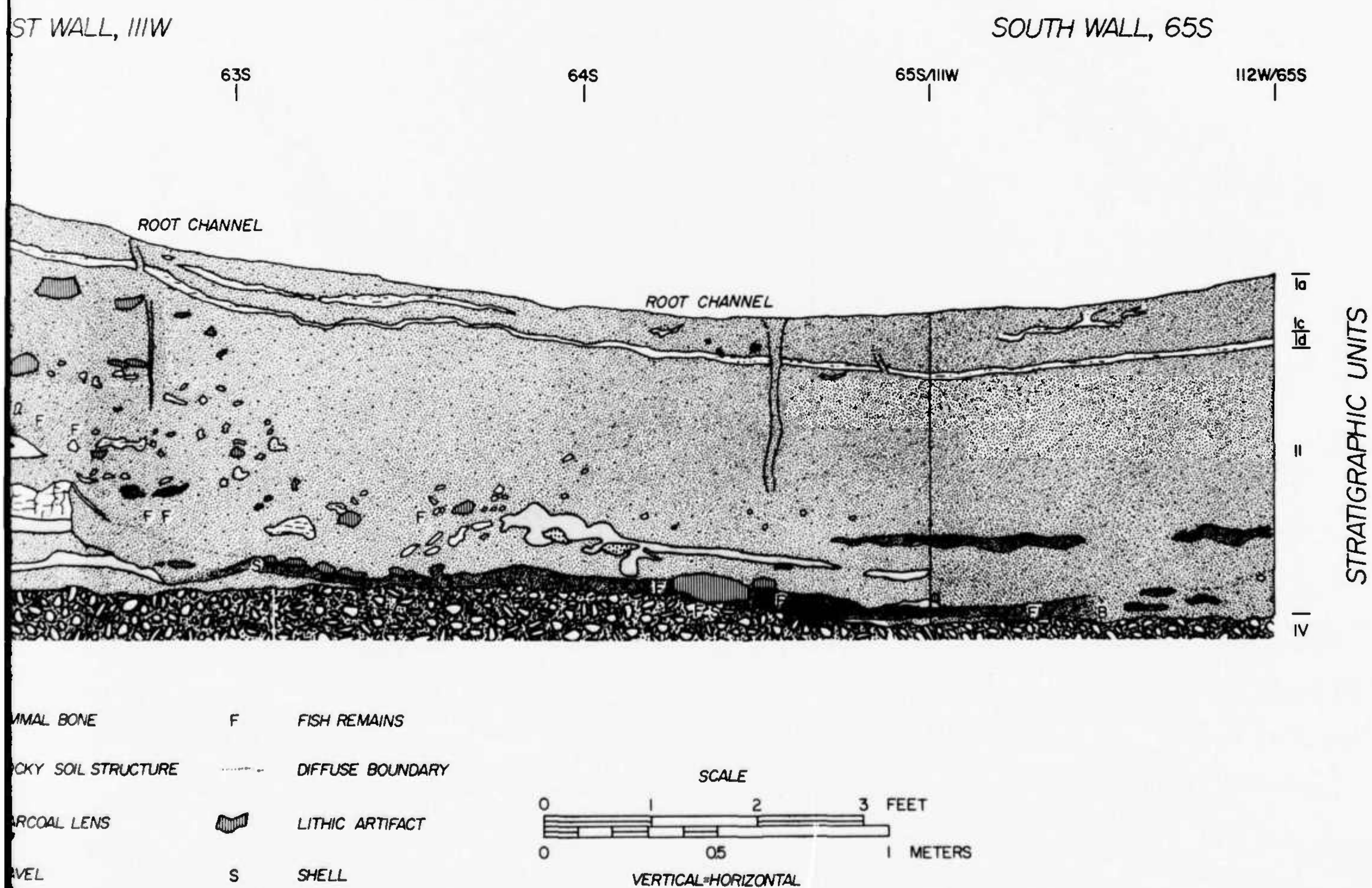


Figure 4-6. Profile Diagram of the East
Test Trench Through Depress
of a Steep, Abrupt Walled P



ile Diagram of the East and South Walls of the
Trench Through Depression 30 Showing One Side
Steep, Abrupt Walled Pit Feature

have been dumped onto the ring zone during initial pit excavation. This author is not aware of any similar patterns reported from other Plateau pit features.

Stratum III

Stratum III has been dated from one sample of a concentration of particulate charcoal. The sample (TX-3304) was removed from the west wall of the test trench in D-128 (Figure 4-4). It clearly underlaid the Stratum II pit below D-128 and was located within the lowermost silt unit of Stratum III, dating it to 2472±110 B.P.

This date also serves as an approximate upper limiting date for the one concentration of cultural remains found at the Stratum III/IV contact. The association of this date with the cultural remains is stratigraphic, not direct.

The depositional units of Stratum III are discussed in detail in Appendix B.

Stratum IV

Although datable samples have not been recovered, the age of this stratum can be approximated. It must be earlier than 2,400 B.P. based upon the tentative Stratum III date. Also, coatings of calcium carbonate are found on the bottoms of individual clasts within the stratum. This corresponds to the first stage of carbonate horizon development (Birkeland 1974: 116). Although rates of formation are locally variable, the process is measured in thousands of years.

As noted by Hassan (1977:146-147) the island probably initiated as a mid-channel gravel bar. This gravel was deposited during a period of higher flow regime than exists at present.

Further investigation of the stratum is hampered by the high water table. Where it has been exposed; however, the imbricated nature of the clasts indicates flow in the present direction of the Snake River.

Laboratory Analysis and Results

A discussion of the procedures used for analysis, the resulting data, and their interpretations are detailed in Appendix B. The reader is referred to this appendix for a complete discussion.

This section will briefly outline the results of the laboratory analysis. Granulometric analysis was used to determine the possible origin of the Stratum III sands. This problem is relevant to processes responsible for initial formation of the island and its initial occupation by prehistoric people.

In 1961, Osborne and Crabtree reported the existence of artifacts within a "beach" sand near the cobble base of Strawberry Island (Osborne and Crabtree 1961:20). Following this, Mierendorf (1977), in a preliminary sediment analysis, reported a stratigraphic unit (later labeled "Stratum III") with comparable grain-size properties of active dunes from the southern tip of the island. Hassan (1977) stated some possible paleoenvironmental implications for such an occurrence. Recognizing a lack of sufficient evidence as a basis for any conclusions and yet the relevance of the problem to climatic variation and the regional settlement pattern, a more thorough sediment analysis was initiated (Appendix B).

Samples from modern environments were compared with subsurface samples of unknown depositional type. The results of the granulometric analysis shows that the Stratum III sands are unlike modern beach or dune sands. When considered along with sedimentary structures and bedforms, the Stratum III sands most closely resemble point bar or channel bar deposits.

The presence of artifacts in primary context indicates that prehistoric people used the island early in its depositional history.

Discussion

Comparison With Previous Investigations

Osborne and Crabtree (1961) reported the results of limited excavation of 45FR5 in 1951. They used stratigraphic evidence for interpretation and reproduced stratigraphic diagrams in their report.

They noted the island was covered with an unbroken "fine, loose, yellow sand under the humus layer" (Osborne and Crabtree 1961:22). Elsewhere this is described as a "Late fill of windblown or water-laid sand, as shown by the loose yellow sand .5-.8 feet from the surface in a consistent and uninterrupted layer" (Osborne and Crabtree 1961:21). This layer corresponds to what is here labeled Stratum I; they did not, however, associate it with any particular event.

Beneath this is an "upper midden stratum" which "contained a high concentration of cultural material" in a dark mottled sand matrix (Osborne and Crabtree 1961:21-22). They believed this stratum represented a long occupational period. This correlated with "Stratum II" used here.

The lowermost cultural layer is a moderately yellow sandy loam containing many thin lenses of charcoal and cultural material. To Osborne and Crabtree, these were considered evidence that earlier "camps" had been used for a shorter duration than the stratum above. It is unclear if they considered this earlier occupation to be associated with housepits.

The lowermost stratum is a layer of sterile gravels.

Hassan (1977), on the basis of six stratigraphic trenches, distinguished four sand units overlying the gravel base of the island. The uppermost is described as a silty sand and correlated with Stratum I. The underlying unit is a medium sand with frequent shell remains and pebbles. This corresponds to Osborne and Crabtree's upper midden stratum and this author's Stratum II. The next lower unit also has cultural remains; it is the same

as Osborne and Crabtree's earlier occupation; this report has recognized this occupation as one of the use levels within Stratum II pits. In the lowermost sand unit, Hassan recognized a pre-housepit occupation corresponding to this author's Stratum III.

In conclusion there is general agreement with the stratigraphic sequence found by Osborne and Crabtree and this author. Agreement is good between the results reported here and by Hassan (1977). These observations support the conclusion that the Stratum III occupation is probably loosely scattered beneath the entire housepit occupation of the Miller Site, but may not be spatially coincident with it.

Environmental Implications

Due to its location near the mouth of the Snake River, the Strawberry Island stratigraphic record is a useful monitor of the regional alluvial chronology. Deposition of the gravel base of the island predates 2,472±110 B.P. on the basis of one C-14 date from the bottom of Stratum III. In his correlation of stratigraphy from a number of locations in central and eastern Washington, Cochran (1978:45-46) has bracketed a period of renewed fluvial deposition from 4,200 B.P. to some time after 2,400 B.P. Possible correlation exists between such renewed fluvial deposition and formation of an initial channel gravel deposit at Strawberry Island. Any more definite statement should require as a first step, dating of samples collected from within Stratum IV.

Deposits overlying the gravels consist of alternating beds of fluvial silts and sands. However, a possible weak structural B horizon is inferred from a number of profiles near the northwest margin of the island. This soil horizon stratigraphically overlies the Stratum III unit C-14 dated at 2,472±110 B.P. This horizon may correlate with a period of soil development at approximately 2,000 B.P. reported for the Lower Snake River Canyon by Hammatt (1977) and in the Lower Palouse River Canyon by Marshall (1971). Cochran (1978) has noted other occurrences dated from about this time in Central Washington. Ames and Green (1979) dated a buried soil along the Lower Clearwater River at about 2,300 B.P.

Sometime around 1,400 B.P. intense aboriginal utilization of the island began. Excavation and re-use of pit facilities, along with other culturally related disturbance processes, have thoroughly mixed natural depositional units after this time.

Finally, the above sequence is capped by a unit of silt and sand deposited in recent historic times. If the causes of this unit, as discussed in the origin of Stratum I are correctly identified, some climatic factors conditioning alluvial processes in the Lower Snake River can be recognized. Historic records show that the largest floods occur when heavy snow falls on frozen ground, followed by abrupt thawing accompanied by rainfall. This sequence of events is rather specific and its rate of prehistoric occurrence would be difficult to demonstrate. Nevertheless, this information is useful in showing that in the past, erosion in the uplands with associated deposition in the Lower Snake River Basin could be triggered by a shift toward colder and wetter winters, especially if such a shift involved decreased plant cover due to less available moisture during the growing season. Such a shift in the seasonal rainfall pattern could have occurred with no change in mean annual precipitation. Thus, major climatic changes are not necessary to substantially alter rates of erosion and sediment deposition within a watershed.

Cultural Implications

This discussion focuses on the cultural meaning that can be assigned to stratigraphic variation at the Miller Site.

As mentioned earlier, numerous aboriginal pits were encountered during excavation. From ethnographic descriptions of Plateau culture and previous archaeological excavations it is known that a variety of functional pit types were used. Among these are storage pits, food processing pits, housepits, ceremonial/communal semisubterranean structures, semisubterranean menstrual huts, hide-smoking pits, and lithic heat treatment pits. The problem is that archaeologists have not, except in rare cases, distinguished these functional types with any certainty in the southern Plateau. As a result, through a tradition of research and informal concensus, Plateau archaeologists have substituted for their ignorance a sort of practical guiding principle. This principle states roughly that one depression (or large pit) plus faith equals one house pit which equals a semipermanent winter village. Few archaeologists have attempted anything more ambitious than this. Southard (1973) postulated a link between "house pit" size and function. Accordingly, pits larger than 28 m^2 in surface area served as multi-family dwellings or were used for specialized, possibly communal functions. Those between 10 and 28 m^2 represent single-family dwellings, cooking huts, sweat lodges, and menstrual huts. Less than 10 m^2 is considered too small for an average family group, and would have served some nonhabitation purpose (Southard 1973:66-67).

Using Southard's size classification, stratigraphic data from the Miller Site was used in the following way. With the aid of profile diagrams and field notes, the area in m^2 was computed for each pit feature. This was done by assuming that the planview outline of each pit described a perfect circle. Next, the pit wall was traced in profile to the termination of the charcoal lens or to where Stratum III units were truncated during pit construction. In those cases where an excavation unit did not expose the entire diameter in profile, the radius was measured from the pit wall to the lowest elevation of the depression, again assuming symmetrical shape. It is expected that the assumptions used here deviate from reality and that a measurement error exists, but the general magnitude of the values obtained should be within reason. The results are shown in Table 4-2. Of the 14 total pits in the sample, 8 (57%) are well below the 10 m^2 area of dwellings, 5 (36%) are within the single-family size range, and 1 (7%) was possibly used communally. Of 10 depressions visible on the site's surface, 6 (60%) fell within the size range which could function as a single-family dwelling.

The technique used here needs a much larger sample in conjunction with other correlates of a pit use (such as a functional analysis of artifacts and analysis of microarchaeological remains). However, from this evidence it is suggested that 60 percent or fewer of the visible site depressions may have been dwellings.

If there are functional differences between pit facilities of different sizes, then we might expect internal stratification to also vary. The criterion chosen to measure this was the number of cultural layers recorded within each pit. By one method, counts were made of charcoal lenses. A second count was made which included all cultural layers including charcoal

Table 4-2. Pit Feature Diameters and Use Zone Levels

			Greater Than 10 m^2		Less Than 10 m^2	
Facility Designation	Diameter (m)	Area (m^2)	# of charcoal strata	all strata	# of charcoal strata	all strata
D65 pit	2.0	3.1	-	-	1	1
D67 pit	3.8	11.3	2	4	-	-
D61 pit	2.6	5.3	-	-	3	4
D114, pit 1	1.1	0.95	-	-	1	3
D114, pit 2	1.0+	0.78+	-	-	1	3
D114, pit 3	2.0	3.1	-	-	2	4
D30 pit	4.0	12.6	3	4	-	-
D128 pit	4.0	12.6	2	2	-	-
D9, pit 1	0.35	0.2	-	-	4	4
D9, pit 2	1.8	2.5	-	-	2	3
D119 pit	5.0	19.6	5	5	-	-
D96 pit	6.0	28.3	5	5	-	-
D76 pit	5.0	19.6	2	3	-	-
OA 200 pit	1.4	1.4	-	-	0	2
		Average Values:	3.2	3.8	1.7	3.4

lenses, layers of shell, fish, or bone, and fire broken rock and pebble lenses. The results are shown in Table 4-2.

Pit facilities larger than 10 m^2 and smaller than 10 m^2 show nearly the same number of internal layers when multiple criteria are counted. When only charcoal lenses are counted, however, there is a difference. Pits larger than 10 m^2 tend to have twice as many charcoal layers as pits smaller than 10 m^2 in area. Again, the sample is too small to be certain that the correlation is not spurious. On the other hand, this may be a pattern related to the function, duration of use, frequency of use, and periodicity (Anderson 1979) of functionally different pit types.

Archaeological Implications

In an earlier section of this paper, pit structure was divided into two parts, the ring zone and the use zone. The implications of this structure to excavation techniques and analysis will be discussed.

Archaeologists excavating pit features on the Plateau have occasionally addressed the interpretive problems stemming from aboriginal re-use of pits. Again, from ethnographic descriptions and archaeological excavations, it is known that pits were used at successive intervals. Re-excavation or cleaning of a house floor probably occurred with each use. Yet, archaeologists have generally failed to consider this behavior systematic, to model the resultant pattern, or to develop analytic strategies to deal with it. Those who have disagree:

> Because the pit house was built on ground which had been occupied for many centuries, the process of construction, involving the scooping out of a saucer-shaped floor, and the re-depositing of this removed material in a built-up rim, resulted in considerable mixing of artifacts. . .
>
> Therefore, only certain undisturbed layers within a portion of the site are considered reliable and artifacts from these layers only are catalogued and analysed below. Artifacts included are those recovered from the grey loam overlying the pit house floor and the grey loam on the outer slope of the rim. No artifacts from the artificially built-up rim (compact grey-brown loam) or from the pre-pit house strata (compact red-brown loam) are considered (Mitchell 1963:58-59).

> Pit houses are not good receptacles for archaeological evidence. Ethnographically, the data for both the Interior and Columbia Plateaus indicated the use of these structures during the winter months only, with abandonment in the spring. Before their use next fall, the houses would be cleaned, repaired, or changed . . . The net effect of this reuse would be a definite re-cycling of the artifact through shifting of the floor and rim debris. The interhouse area presumably would contain relatively undisturbed activity and debris build-up, while the interiors of the houses would be constantly changing (Turnbull 1973:25-26).

> Detailed recording of stratigraphic units suggests that intermittent excavation by the inhabitants of the island resulted in the sectioning of already existing archaeological deposits . . . . A result is the stratigraphic mixing of components thus excavated. It is my judgement that only the most recent occupation would be free of this type of mixing process and therefore the most coherent for interpretation and delineation of activities (Cleveland 1978:47-48).

These quoted statements imply a distinction between what I have called a "ring zone" and a "use zone." The former refers to the earth (and its artifactual content) piled up around the edges of a pit facility (house, storage, food processing, or otherwise) during its construction and use. The use zone refers to the area inside of the pit and the characteristic sediments it contains.

At the Miller Site, a ring zone is recognized by reverse stratigraphy (the Stratum III well-sorted sands within Stratum II) and artifact content (high density of fire broken rocks and river pebbles) adjacent to the pit outline. Wherever sediments are weakly stratified, reverse stratigraphy is not prominent. However, if this model of pit structure reflects a recurrent pattern, we should analytically separate the ring zone from the use zone by whatever means possible. The need for such a distinction is the one common theme underlying the statements quoted above.

An example will demonstrate the usefulness of the pit structure concept. Numerous "house pits" from the Plateau have been C-14 dated. Due to the high cost of C-14 dating, usually one or two samples are all that can be justified per "house pit." Such dates are generally accepted as reliable of the time of use or occupation. However, one implication of the pit structure concept is that a carbon sample collected from the use zone may be interpreted quite differently from one collected from the ring zone. Specifically, suppose the pit being dated shows multiple charcoal lenses within the use zone. Furthermore, beneath the pit is a cultural stratum representing an earlier occupation. In such a case, a C-14 sample from the ring zone could date any one of the multiple use periods, early or late, or the earlier occupation if pit construction involved intrusion into the earlier stratum.

A sample collected from the use zone should be more reliable, however. Such a sample is more likely to represent an actual time of facility use. Since there is no way of knowing how many levels have been destroyed by cleaning or re-excavation prior to re-use, it is never certain that the lowest use level represents the initial use of the pit.

But complete re-excavation of pits prior to each use did not usually occur, because most Plateau "house pits" show successive use levels within the pit. These should be useful for deriving an approximate time range of use or for a relative indication of earlier or later episodes of use.

As might be expected, failure to control for use zone versus ring zone provenience when selecting carbon samples for dating has led to seemingly anomalous results. For example:

> At ElRn3 the distribution of the sample dates below the surface present(s) a confusing picture. The deeper the sample is below the surface the later the date appears to be. This may be the result of a mixing of the deposit during the subsequent later occupation. The earliest date, Gak-4322, is found just below the surface in the brown loam layer near the periphery of the depression in Unit One.
>
> The latest date, Gak-4321, occurs 33 centimeters below the surface in Unit Four near the center of the house depression (Whitlam 1976:13-14).

The "confusing picture" described above is predictable and should be considered a manifestation of a recurrent pattern.

Using the concept of pit structure, the series of C-14 dates (Table 4-1) were organized according to depth below Strata I/II contact and ring zone vs. use zone provenience. All samples except the one from Stratum III were associated with pit facilities. The results are shown in Table 4-3.

Two trends are shown. The first is that the upper 40 centimeters of the ring zone shows a wide range of dates with no apparent relationship to depth. This is expected if the ring zone is indeed a mix of older with younger cultural sediments. The other trend is an approximate direct correlation between depth and age in the use zone. However, the relationship is not invariable. For example, sample WSU-1698 is older but closer to the surface than sample WSU-1894. However, the latter sample was from a subsurface pit adjacent to D-96.

Summary

Stratigraphy at the Miller Site was correlated in four strata labeled Stratum I through IV from top to bottom. Stratum I is historic in age and represents a set of seasonal flood deposits. The lowermost of these dates to the flood of 1894 or possibly 1948.

Stratum II properties reflect intensive aboriginal use of the island between 1,400 B.P. and 300 B.P. Numerous pit features and other cultural debris occur throughout.

Stratum III consists of channel bar or point bar sands interbedded with very fine sands and silts. The stratum is bracketed between 2,400 B.P. and 1,400 B.P. Properties of a weakly developed soil occur in a unit near the top of the stratum. Artifacts are present but infrequent.

Stratum IV is a coarse gravel unit that predates 2,400 B.P. It is culturally sterile.

Aboriginal pit features are considered to have two parts, a use zone and a ring zone. The use zone is the center of the pit and is recognized by one and frequently more successive stratigraphic levels. The ring zone is created and added to by pit excavation and cleaning. It is recognized

Table 4-3. Stratigraphic Provenience of C-14 Dates*
Relative to Facility Structure

Laboratory #	Surface Provenience	Stratum	Date	Depth Below Strata I-II Contact	Ring Zone	Use Zone
WSU-1889	D119	II	140±80	6 cm	+	-
WSU-1892	Open Area 200	II	260±90	40 cm	+	-
WSU-1890	D96	II	450±80	10-20 cm	+	-
WSU-1891	D76	II	480±80	10-20 cm	+	-
WSU-1893	D76	II	410±130	60-70 cm	-	+
WSU-1894	D96 House 2	II	440±90	90-100 cm	-	+
WSU-1699	D119	II	530±80	60 cm	-	+
WSU-1698	D96	II	610±90	75 cm	-	+
WSU-2241	D9	II	1395±80	120 cm	-	+
Tx-3304	D128	III	2472±110	150 cm	-	-

*All samples are charcoal; computed with a 5570 year half-life

by reverse stratigraphy. It is suggested that C-14 dated samples will be interpreted differently depending upon their provenience relative to pit structure.

Finally, stratigraphic evidence of pit size has been used to infer that possibly 60 percent or fewer of the depressions visible on the Miller Site may represent the remains of habitations. The remaining proportion may have been used as storage or processing pits and the larger ones for multi-family or communal purposes.

REFERENCES CITED

Ahlbrandt, Thomas S.
1979 Textural Parameters of Eolian Deposits. In A Study of Global Sand Seas, edited by Edwin D. McKee, pp. 21-51. Geological Survey Professional Paper 1052. US Government Printing Office, Washington, D.C.

Ames, Kenneth M., and James P. Green
1979 A Holocene Geochronology from the Lower Clearwater River, Central Idaho. Ms. on file with authors.

Anderson, Dana Beth
1979 Sources of Patterning in Spatial Distributions. Programs and Abstracts of Papers Presented at the Forty-fourth Annual Meeting, Society for American Archaeology, Vancouver, B.C.

Birkeland, Peter W.
1974 Pedology, Weathering, and Geomorphological Research. Oxford University Press, Inc., New York.

Boucher, P. R.
1970 Sediment Transport by Streams in the Palouse River Basin, Washington and Idaho, July 1961-June 1965. Geological Survey Water Supply Paper 1899-C. US Government Printing Office, Washington, D.C.

Brauner, David R.
1976 Alpowai: The Culture History of the Alpowa Locality, 2 vol. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Caldwell, Warren W. and Oscar L. Mallory
1967 Hells Canyon Archaeology. Publications in Salvage Archaeology, No. 6. River Basin Surveys, Lincoln.

Carson, Robert J., Charles F. McKhann, and Mark H. Pizey
1978 The Touchet Beds of the Walla Walla Valley. In The Channeled Scabland, edited by Victor R. Baker and Day Nummedal. Planetary Geology Program, Office of Space Science, National Aeronautics and Space Administration, Washington, D.C.

Chance, David H., Jennifer V. Chance, and John L. Fagan
1977 Kettle Falls: 1972. Laboratory of Anthropology, University of Idaho, Anthropological Research Manuscript Series Number 31.

Cleveland, Gregory C.
1978 Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 72.

Cleveland, Gregory C., Bruce Cochran, Judith Giniger, and Hallett Hammett
1976 Archaeological Reconnaissance on the Mid-Columbia and Lower Snake River Reservoirs for the Walla Walla District Army Corps of Engineers. Washington Archaeological Research Center, Washington State University, Project Reports Number 27.

Cochran, Bruce D.
1978 Late Quaternary Stratigraphy and Chronology in Johnson Canyon, Central Washington, Unpublished Master's Thesis, Department of Anthroplogy, Washington State University.

Cole, David L.
1965 Report on Archaeological Research in the John Day Dam Reservoir Area-1964. Interim Report 1964-1965. Ms. on file, Museum of Natural History, Eugene, Oregon.

1968 Report on Archaeological Research in the John Day Dam Reservoir Area-1967. Ms. on file, Museum of Natural History, Eugene.

Cressman, L. S.
1956 Klamath Prehistory. Transactions of the American Philosophical Society 46(4).

Daugherty, Richard D.
1952 Archaeological Investigations in O'Sullivan Reservoir, Grant County, Washington. American Antiquity 17(4):374-380.

Daugherty, Richard D., Barbara A. Purdy, and Roald Fryxell
1967 The Descriptive Archaeology and Geochronology of the Three Springs Bar Archaeological Site, Washington. Laboratory of Anthropology, Washington State University, Report of Investigations Number 40.

Dohm, Karen
1978 Results of the Second Test Excavations Within the Proposed Right-of-Way of SR 151, Beebe Orchard, Chelan County, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 74.

Easterbrook, Don J., and David A. Rahm
1970 Landforms of Washington. Union Printing Co., Bellingham, WA.

Farrand, William R.
1980 Review of Geoarchaeology, Earth Science, and the Dust, edited by D. A. Davidson and M. L. Shackley. American Antiquity 45:216-219.

Folk, Robert
1966 A Review of Grain-Size Parameters. Sedimentology 6:73-93.

1974 *Petrology of Sedimentary Rocks*. Hemphill Publishing Co., Austin, Texas.

1975 Brazos River Bar: A Study in the Significance of Grain Size Parameters. *Journal of Sedimentary Petrology* 27:3-26.

Foss, J. E., W. R. Wright, and R. H. Coles
1975 Testing the Accuracy of Field Textures. *Soil Science Society of American Proceedings* 39:800-802.

Friedman, G. M.
1961 Distribution Between Dune, Beach, and River Sands from Their Textural Characteristics. *Journal of Sedimentary Petrology* 31:514-529.

1962 On Sorting, Sorting Coefficients, and the Log-Normality of the Grain-Size Distribution of Clastic Sandstones. *Journal of Geology* 70:737-753.

1967 Dynamic Processes and Statistical Parameters Compared for Size Frequency Distribution of Beach and River Sands. *Journal of Sedimentary Petrology* 37:327-354.

Fryxell, Roald (in cooperation with Richard D. Daugherty)
1963 Late Glacial and Post Glacial Geological and Archaeological Chronology of the Columbia Plateau, Washington. *Laboratory of Anthropology, Washington State University, Reports of Investigations Number* 23.

Gilkeson, Raymond A.
1962 Washington Soils and Related Physiography-Columbia Basin Irrigation Project. *Washington Agricultural Experiment Stations, Washington State University, Stations Cicular* 327.

Gladfelter, Bruce G.
1977 Geoarchaeology: The Geomorphologist and Archaeology. *American Antiquity* 42(4):519-538.

Grabert, G. F.
1968 North-Central Washington Prehistory: A Final Report on Salvage Archaeology in the Wells Reservoir - Part 1. *Department of Anthropology, University of Washington Reports in Archaeology*, No. 1, Seattle.

Grolier, M. J., and J. W. Bingham
1978 Geology of Parts of Grant, Adams, and Franklin Counties, East-Central Washington. *Department of Natural Resources, Division of Geology and Earth Resources, Bulletin* 71.

Hammatt, Hallett H.
1977 *Late Quaternary Stratigraphy and Archaeological Chronology in the Lower Granite Reservoir Area, Lower Snake River, Washington*. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University.

Harkins, S. Kent, Christopher L. Brown, and William C. Gray
1976 A Preliminary Faunal Analysis from Strawberry Island (45FR5), Franklin County, Washington: With Emphasis on the Utilization of the Mammalia. Ms. on file, Department of Anthropology, Washington State University.

Hassan, Fekri
1977 Stratigraphic and Geomorphological Setting of the Miller Site, Strawberry Island, Appendix 2. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976, a Late Prehistoric Village Near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Reports 46.

1978 Sediments in Archaeology: Methods and Implications for Palaeo Environmental and Cultural Analysis. Journal of Field Archaeology 5:197-213.

1979 Geoarchaeology: The Geologist and Archaeology. American Antiquity 44(2):267-270.

Holmes, Brian G.
1966 The Schaake Site--a New Study. Unpublished Master's thesis, Department of Anthropology, University of Washington, Seattle.

Hunt, Charles B.
1967 Physiography of the United States. W. H. Freeman and Company, San Francisco, CA.

Kaiser, V. G.
1961 Historical Land Use and Erosion in the Palouse--a Reappraisal. Northwest Science 35(4):139-153.

Krieger, Herbert
1928 A Prehistoric Pithouse Village on the Columbia River at Wahluke, Grant County, Washington. Proceedings of the US National Museum 73(11):1-29.

Krumbein, W. C.
1934 Size Frequency Distribution of Sediments. Journal of Sedimentary Petrology 4:65-77.

Kukal, Zdenek
1971 Geology of Recent Sediments. Academic Press, New York.

Leonhardy, F. C., G. S. Schroedl, J. Bense, and S. Beckerman
1971 Wexpusnime (45GA61): Preliminary Report. Laboratory of Anthropology, Washington State University, Report of Investigations Number 49.

Mapes, B. E.
1969 Sediment Transport by Streams in the Walla Walla River Basin, Washington and Oregon, July 1962-June 1965. Geological Survey Water Supply Paper 1868. US Government Printing Office, Washington, D.C.

Marshall, Alan G.
1971 An Alluvial Chronology of the Lower Palouse River Canyon and its Relation to Local Archaeological Sites. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Mason, C. C., and R. L. Polk
1958 Differentiation of Beach, Dune, and Aeolian Flat Environments Size Analysis, Mustang Island, Texas. Journal of Sedimentary Petrology 28:211-226.

McCoy, Patrick C.
1971 Archaeological Salvage of the Little's Landing Site, 45CH64. Ms. on file, Laboratory of Anthropology, Washington State University, Pullman.

Mierendorf, Robert R.
1977 Sediment Analysis, Section IV. In Archaeological Reconnaissance on the Mid Columbia and Lower Snake River Reservoirs for the Walla Walla District, Army Corps of Engineers. Washington Archaeological Research Center, Washington State University, Project Report Number 27.

Mitchell, Donald H.
1963 Esilao - A Pit House Village in the Fraser Canyon, British Columbia. Master's thesis, Department of Anthropology, University of British Columbia, Vancouver.

Nelson, Charles M.
1969 The Sunset Creek Site (45KT28) and Its Place in Plateau Prehistory. Laboratory of Anthropology, Washington State University, Reports of Investigations Number 47.

Osborne, Douglas
1957 Excavations in the McNary Reservoir Basin near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Paper 8:1-258, US Government Printing Office, Washington, D.C.

Osborne, Douglas and Robert H. Crabtree
1961 Two Sites in the Upper McNary Reservoir. Tebiwa 4(2):19-36.

Osborne, Douglas, Robert Crabtree, and Alan Bryan
1952 Archaeological Investigations in the Chief Joseph Reservoir. American Antiquity 17(4):360-373.

Pettijohn, Francis J.
1975 Sedimentary Rocks, third edition. Harper and Row, New York.

Reineck, H. E. and I. B. Singh
1973 Depositional Sedimentary Environments. Springer-Verlag, New York.

Sanger, David
1970 The Archaeology of the Lochnore-Nesikap Locality, British Columbia. Syesis 3:Supplement 1.

Shiner, Joel L.
1952 A Preliminary Report on the Archaeology of Site 45WW6 on the Columbia River, Washington. Columbia Basin Project, River Basin Surveys, Smithsonian Institution, Eugene.

1961 The McNary Reservoir: A Study in Plateau Archaeology. Bureau of American Ethnology, Bulletin 179, River Basin Surveys 23:149-266. Washington, D.C.

Soil Survey Staff
1951 Soil Survey Manual. Agricultural Handbook No. 18. U.S. Department of Agriculture, Washington, D.C.

Southard, Michael D.
1973 A Study of Two Northwest Housepit Populations. Northwest Anthropological Research Notes 7(1):6-83.

Stallard, Bruce
1957 An Archaeological Survey in the Wells Reservoir in the State of Washington. Laboratory of Anthropology, Washington State University, Reports of Investigations Number 1.

Strong, William D., Egbert W. Schenck, and Julian H. Steward
1930 Archaeology of the Dalles-Deschutes Region. University of California Publications in American Archaeology and Ethnology, 29(1):1-154.

Stryd, A. H.
1972 Housepit Archaeology at Lillooet, British Columbia: The 1970 Field Season. B.C. Studies, 14:17-46.

Swanson, Earl H., Jr.
1958 The Shaake Village Site in Central Washington. American Antiquity 24:161-171.

1960 Archaeological Survey of the Methow Valley, Washington. Tebiwa 2(1):72-87.

1962 The Emergence of Plateau Culture. Occasional Papers of the Idaho State College Museum 8.

Turnbull, Christopher
1973 Archaeology and Ethnohistory on the Arrow Lakes, Southwestern British Columbia. Ph.D. dissertation, Department of Archaeology, University of Calgary.

U.S. Army Corps of Engineers
1949 Report on Flood of May-June 1948, Columbia River and Tributaries Below Yakima River. Portland District.

U.S. Army Engineer Division, North Pacific
1969 Memorandum Report, Columbia River Basin, Lower Columbia River Standard Project Flood and Probable Maximum Flood. Portland, OR.

U.S. Congress
1898 Survey of Snake River, Washington, from Its Mouth to Riparia. House of Representatives, Document 411, 55th Congress, 2nd Session.

1933 Snake River and Tributaries. House of Representatives, Document 190, 73rd Congress, 2nd Session.

U.S. Geological Survey
1949 Floods of May-June 1948 in Columbia River Basin. Geological Survey Water-Supply Paper 1080. US Government Printing Office, Washington, D.C.

Victor, Earl
1935 Some Effects of Cultivation Upon Stream History and Upon the Topography of the Palouse Region. Northwest Science 9(3):18-19.

Visher, Glenn S.
1969 Grain Size Distributions and Depositional Processes. Journal of Sedimentary Petrology 39(3):1074-1106.

Warren, Claude N.
1968 The View from Wenas: A Study in Plateau Prehistory. Occasional Papers of the Idaho State Museum 24, Pocatello.

Whitlam, Robert
1976 Archaeology in the Williams Lake Area, British Columbia. Occasional Papers of the Archaeological Sites Advisory Board of British Columbia, No. 1, Victoria.

CHAPTER 5

THE FAUNAL ASSEMBLAGES

by

Randall F. Schalk and Deborah Olson

Detailed information on archaeological faunal collections from sites of any kind in the southern Columbia Plateau is very scarce. Such information for late prehistoric residential sites is even rarer. At the time the investigations reported here were carried out, there was only one other housepit site for which any faunal data, useful for comparative purposes, had been published for the entire Lower Snake or Middle Columbia--Alpowa in the Lower Granite Reservoir (Brauner 1976; Lyman 1976). The Alpowa faunal assemblages, unfortunately, tended to be exceptionally small. If we further restricted the discussion to sites that are similar to Strawberry Island in their size, age, and spatial organization of surface features, we would be without any comparative basis for approaching the study of faunal materials from this site. Osborne (1957:118) and Shiner (1961:221) provided only nonquantitative discussions of the faunal remains from housepit sites in the McNary Reservoir.

When it is recognized that all scientific measurement must be relative to some standard, certain difficulties become apparent. Intersite faunal comparisons are limited by the lack of published data and consequently there is little to which we can compare the Strawberry Island faunal data. In view of this situation and the objectives of this particular project, the focus here is upon questions pertaining primarily to intrasite variability.

Two primary research questions were identified in 1978 as being particularly appropriate to the investigation of this site (see Chapter 2). The first question dealt with the nature or degree of adaptive stability during late prehistoric times (2,500-220 B.P.). Investigation of this question required comparative analysis of collections of different ages. It was known from radiocarbon dates submitted from the 1976-1977 seasons that there were occupations represented in the site spanning at least the last six centuries of the prehistoric period (see Table 4-1). It was assumed that more extensive exploration of the site would probably produce even earlier housepit occupations, but whether it did or not, diachronic comparisons of collections from different portions of the deposits offered the logical way to operationalize this research question.

The second question had to do with site structure. In particular, we wanted to know what, if any, differences there might be in the content of structures which from surface evidence were clearly

quite variable in their size, shape, and spatial relationship to other structures. An important and related aspect of our investigation of site structure involved the question of the extent to which the site deposits conformed to a long term "accretional model" as discussed in Chapter 2.

This chapter proceeds with a discussion of the faunal identification procedures. After this, faunal assemblages are discussed for the entire site, the left and right bank housepit clusters, the upper and lower levels of the 1978-1979 block excavation (OA-78), and the numerous test pits scattered across the site, respectively.

Procedures Utilized in the Faunal Identifications

Much of the data utilized in this section are derived from the identification of all mammalian faunal remains recovered during the 1978 and 1979 seasons. In addition, a significant portion of the faunal materials recovered during the 1976 and 1977 seasons was re-examined to insure compatibility of identification procedures with those used on the 1978 and 1979 faunal data. In particular, portions of the faunal collections from depressions 117, 119, 76, 96, and OA-200 were incorporated. Detailed identifications were concentrated on the mammalian faunal remains. Birds, reptiles, and amphibians, all of which are represented in very small numbers in the collections, were identified as such, counted, and segregated for future, more exacting identification and analysis. Fish remains were subjected to an intermediate degree of identification; all vertebrae have been identified and counted as Salmonidae, Catostomidae (sucker), or "other fish." Nonvertebral fish bones were simply counted and tabulated as "fish" elements. Again, fish remains have been segregated to facilitate future, more exhaustive identifications when those become appropriate or possible.

As is generally the case with prehistoric faunal collections from this region, only a small percentage (10.6% in this case) is identifiable to the level of family, genus, or species. Where possible, elements not identifiable to one of these three levels have been assigned to one of four body size classes. The use of generalized size classes to maximize the sample of identified bone has been recognized as an important technique since 1965 (Uerpmann 1973; Ziegler 1965, 1973). This technique has been applied to various faunal studies in the Plateau (e.g., Kenaston 1966, Gustafson 1972, Lyman 1976, and Harkins 1980). Unfortunately the size classes used have rarely been explicitly defined and when defined rarely include the same range of taxa. The size classes utilized in this analysis are based upon those suggested by Uerpmann (1973) and are defined as follows (Uerpmann 1973:309; Olson 1980:263):

1. Large mammal: includes ungulates with live weights ranging from 225-900 kg (500-2,000 pounds); bison, horse, and elk are the only mammals of this size class that occur in archaeological sites from this region.

2. Medium mammal: includes animals ranging from 22.5-214 kg (50-475 pounds); includes pronghorn, deer, mountain sheep, and bear.

3. Small mammal: includes fauna with live weights that range from 0.5-27 kg (1-60 pounds); examples in this size class include ground squirrel, rabbit, beaver, and the canids.

4. Small rodent-sized mammal: includes the very small rodents and shrews, all weighing less than 0.5 kg (about 1 pound).

A substantial proportion of all faunal items (22.5%) from the site are not identifiable even to the level of a body size category and these are simply listed as "unidentifiable."

Though not presented in this report, data pertaining to various sorts of bone breakage patterns, burning, cut marks, gnawing, and so on have been tabulated for mammalian faunal remains and discussed elsewhere (Olson 1983).

The Composite Faunal Assemblage

A total of 51,322 individual bone items constituting about 80 percent of all those recovered in the WSU excavations are considered here. The number of identified specimens (NISP) for those excavation areas yielding faunal remains are presented in Table 5-1. The NISP values include all identified (size classes, family, genus, and species) specimens. The number of unidentified specimens are also listed in Table 5-1. This table constitutes the faunal data base utilized throughout most of the analyses discussed in the remainder of this chapter. Table 5-2 shows minimum number of individuals (MNI) data for the total identified faunal sample. The rare taxa that were identified are listed in Appendix D. Throughout most of the remainder of this chapter NISP counts are utilized because in this study MNI counts did not seem very useful. The most obvious problem with MNI's in this case is that the numbers are so low that comparisons of faunal assemblages from different areas of the site are greatly inhibited. Since the excavation areas are widely dispersed over a very large site and provide samples from deposits spanning at least 12 centuries, many of the qualities that would make MNI's a useful index do not exist.

A histogram of the relative frequencies of faunal items in the composite site assemblage is shown at the top of Figure 5-1. Some of the more important characteristics of this histogram will be mentioned before proceeding with the various areas of the site. It is assumed that the frequencies of faunal elements do not reflect in any simple way the quantitative economic importance of particular resources. Rather, they provide a relative measure for the comparison of different areas of the site to one another or assemblages from this site to those from other sites.

Table 5-1. Taxonomic frequencies by number of identified specimens (NISP) for various excavation units.

Excavation Area	*Cervus canadensis*	*Odocoileus* sp.	*Antilocapra americana*	*Lepus* sp.	*Sylvilagus nuttalli*	*Sylvilagus idahoensis*	*Citellus* sp.	*Perognathus parvus*	Cervidae	Canidae	Leporidae	Cricetidae	Large mammals (indet.)	Medium mammals (indet.)	Small mammals (indet.)	Small rodents (indet.)	Salmonidae	Catostomidae	Fish (indet.)	Bird	Reptile/ Amphibian	Unidentifiable	TOTAL
D-9	-	26	7	14	4	-	-	-	-	-	47	-	-	610	75	3	82	5	206	10	-	368	1,459
D-30	1	-	-	23	1	-	-	63	-	-	-	-	-	117	70	16	21	2	119	-	31	49	513
D-44	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	3	6
D-45	-	2	32	13	5	-	2	-	-	1	3	-	2	579	97	1	10	2	140	3	-	216	1,108
D-46	-	3	9	19	-	-	-	-	-	-	5	-	-	565	62	3	150	1	862	2	-	178	1,859
D-47	-	-	5	48	-	-	-	-	-	-	19	-	-	190	145	1	272	2	771	5	-	206	1,664
D-49	-	-	-	5	-	-	-	87	-	1	1	-	-	59	32	-	6	1	12	-	-	15	219
D-56	-	1	-	-	-	-	-	-	-	-	-	3	-	2	-	9	4	4	106	3	-	8	141
D-59	-	-	5	18	1	-	-	-	-	-	1	-	-	122	44	-	-	-	19	-	-	61	271
D-61	-	3	-	11	3	-	-	-	-	-	26	1	-	31	14	4	68	2	52	-	-	77	292
D-65	-	-	-	-	-	-	-	-	-	-	3	1	-	12	4	23	1	-	21	3	1	187	269
D-67	-	-	12	3	1	-	-	-	-	-	3	1	-	91	10	14	4	-	1	-	7	18	317
D-76	-	3	93	195	3	-	-	-	-	-	-	-	2	179	1	7	42	4	3	-	-	-	532
D-81 (N75/E20)	-	-	-	1	-	-	-	-	-	-	-	-	-	10	-	-	5	-	2	-	-	2	20
D-96	-	7	105	367	10	-	21	-	-	5	-	-	21	1055	258	32	262	6	70	-	-	10	2,230
D-114	1	-	2	30	1	-	2	-	-	-	6	1	-	77	82	3	277	-	86	-	-	92	660

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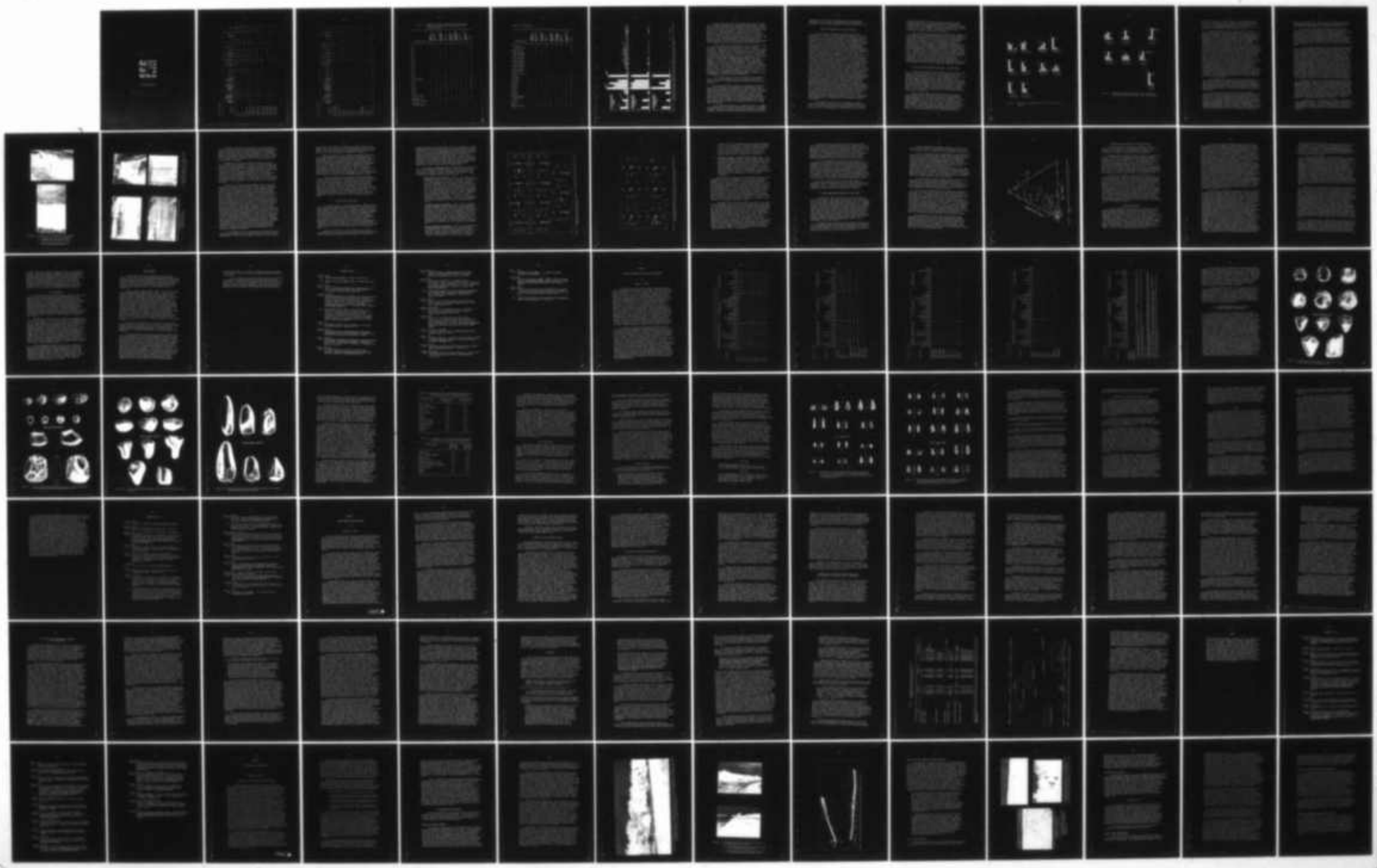

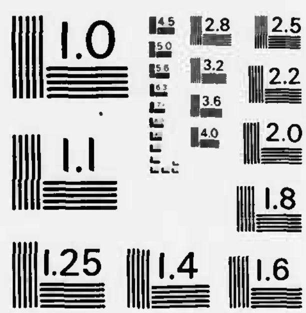

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 5-1. (Continued)

Excavation Area	Cervus canadensis	Odocoileus sp.	Antilocapra americana	Lepus sp.	Sylvilagus nuttalli	Sylvilagus idahoensis	Citellus sp.	Perognathus parvus	Cervidae	Canidae	Leporidae	Cricetidae	Large mammals (indet.)	Medium mammals (indet.)	Small mammals (indet.)	Small rodents (indet.)	Salmonidae	Catostomidae	Fish (indet.)	Bird	Reptile/ Amphibian	Unidentifiable	TOTAL
D-117	-	6	364	291	18	8	19	1	2	-	599	2	16	5811	278	47	175	6	571	68	1	2547	10,830
D-119	-	1	120	118	16	3	2	3	10	1	358	2	1	3456	191	16	234	6	532	75	1	2419	7,565
D-128	-	1	28	10	5	-	-	-	-	2	16	-	-	1112	133	-	24	-	177	3	-	732	2,244
D-OAH	-	-	25	143	4	-	-	-	-	2	143	-	3	1534	228	9	292	2	668	19	-	1019	4,071
D-AA (S13/W68)	-	-	2	-	4	-	-	-	-	1	10	-	-	55	4	1	32	-	253	-	-	38	400
Open Area (entire sample)	10	11	136	690	75	18	5	31	-	14	986	2	7	4440	1834	163	948	5	2253	75	-	2912	14,621
Open Area (lower levels)	-	-	19	51	-	-	-	-	-	-	11	-	15	397	111	11	475	1	1019	21	-	147	2,336
Open Area (upper levels)	10	11	59	579	68	18	2	4	-	13	916	-	3	3804	1099	71	406	4	991	54	-	2598	10,710
Open Area 200	-	1	31	20	-	-	-	-	-	1	25	-	4	836	9	-	20	3	11	1	-	570	1,532
S5/W65 (between D-47 & D-46)	-	-	-	-	-	-	-	-	-	-	-	-	-	24	1	2	4	1	14	1	-	5	52
S3/W65 (between D-47 & D-46)	-	-	-	4	-	-	-	-	-	-	1	-	-	1	10	3	146	-	66	-	-	3	234
S13/W65 (between D-45 & D-46)	-	4	16	62	-	-	-	-	-	-	-	-	-	223	67	-	33	1	64	1	-	112	583
S18/W56 (between D-44 & D-45)	-	-	-	-	-	-	-	-	-	-	-	-	-	15	1	-	-	-	1	-	-	2	19

Table 5-1. (Continued)

Excavation Area	Cervus canadensis	Odocoileus sp.	Antilocapra americana	Lepus sp.	Sylvilagus nuttalli	Sylvilagus idahoensis	Citellus sp.	Perognathus parvus	Cervidae	Canidae	Leporidae	Cricetidae	Large mammals (indet.)	Medium mammals (indet.)	Small mammals (indet.)	Small rodents (indet.)	Salmonidae	Catostomidae	Fish (indet.)	Bird	Reptile/ Amphibian	Unidentifiable	TOTAL
S7/W37 (between D-59 & D-49)	-	-	2	25	-	-	-	-	-	-	7	-	-	127	36	1	1	-	124	-	-	62	385
S1/W63 (near D-47)	-	-	-	1	-	-	-	-	-	-	-	-	3	4	2	5	-	-	-	-	-	5	20
S150/W180	-	-	4	5	1	-	-	-	-	-	-	-	1	221	20	-	2	-	14	-	-	68	336
S125/W180	-	-	-	8	-	-	1	-	-	-	1	-	-	59	25	4	10	1	25	1	-	41	176
S100/W130	-	-	-	1	-	-	-	-	-	-	-	-	-	79	2	1	-	-	2	7	-	7	99
S58/W129	-	-	-	8	-	-	-	-	-	-	-	-	-	27	17	1	1	-	1	-	-	25	80
S25/W80	-	-	1	10	1	-	-	-	-	-	1	-	-	21	6	2	-	-	4	-	-	8	54
S00/E69	-	1	-	1	-	-	-	-	-	-	-	-	-	10	2	-	-	-	2	-	-	-	16
S74/E20	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	-	-	-	-	1	8
S124/E20	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2	7	-	-	12
S75/W280 (below Flood Chute)	-	-	-	5	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	-	-	-	11
S125/W80	-	-	-	-	1	-	-	-	-	-	-	-	-	5	-	-	-	-	-	1	-	-	7
S24/E20	-	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-	11
Beach Collection 1976	-	9	69	12	3	-	-	-	-	1	-	-	22	558	6	1	1	3	19	12	-	-	716

Table 5-2. Mammalian taxonomic frequencies by minimum number of individuals for various excavation units at Strawberry Island.

Excavation Area	Cervus canadensis	Odocoileus sp.	Antilocapra americana	Lepus sp.	Sylvilagus nuttalli	Sylvilagus idahoensis	Citellus sp.	Perognathus parvus	TOTAL
D-9	-	1	1	1	1	-	-	-	4
D-30	1	-	-	1	1	-	-	2	5
D-44	-	-	-	-	-	-	-	-	0
D-45	-	1	3	1	1	-	2	-	8
D-46	-	1	1	2	-	-	-	-	4
D-47	-	-	1	3	-	-	-	-	4
D-49	-	-	-	1	-	-	-	1	2
D-56	-	1	-	-	-	-	-	-	1
D-59	-	-	1	1	1	-	-	-	3
D-61	-	1	-	1	1	-	-	-	3
D-65	-	-	-	-	-	-	-	-	0
D-67	-	-	1	2	1	-	-	-	4
D-76	-	1	2	12	3	-	-	-	18
D-81 (N75/E20)	-	-	-	1	-	-	-	-	1
D-96	1	1	4	15	2	-	6	-	29
D-114	1	-	1	2	1	-	1	-	6
D-117	-	2	12	15	2	2	6	1	40
D-119	-	1	7	5	1	1	1	1	17
D-128	-	1	2	2	1	-	-	-	6
D-OAH	-	-				-	-	-	
D-AA (S13/W68)	-	-	1	-	1	-	-	-	2
Open Area (entire sample)	-	2	2	20	1	3	2	2	33
Open Area (lower levels)	-	-	1	2	1	-	1	-	5

Table 5-2. (Continued)

Excavation Area	Cervus canadensis	Odocoileus sp.	Antilocapra americana	Lepus sp.	Sylvilagus nuttalli	Sylvilagus idahoensis	Citellus sp.	Perognathus parvus	TOTAL
Open Area (upper levels)	1	2	2	14	2	1	1	2	25
Open Area 200	-	1	2	1	-	-	-	-	4
S5/W65 (between (D-47 & D-46)	-	-	-	-	-	-	-	-	0
S3/W65 (between D-47 & D-46)	-	-	-	1	-	-	-	-	1
S13/W65 (between D-45 & D-46)	-	1	2	4	-	-	-	-	7
S18/W56 (between D-44 & D-45)	-	-	-	-	-	-	-	-	0
S7/W37 (between D-59 & D-49	-	-	1	1	-	-	-	-	2
S1/W63 (near D-47)	-	-	-	1	-	-	-	-	1
S150/W180	-	-	1	1	1	-	-	-	3
S125/W180	-	-	-	1	-	-	1	-	2
S100/W130	-	-	-	-	-	-	-	-	0
S58/W129	-	-	-	1	-	-	-	-	1
S25/W80	-	-	1	1	1	-	-	-	3
S00/W69	-	1	-	1	-	-	-	-	2
S74/E20	-	-	-	-	-	-	-	-	0
S124/E20	-	-	-	1	-	-	-	-	1
S275/W280 (below flood chute)	-	-	-	1	-	-	-	-	1
S125/W80	-	-	-	-	1	-	-	-	1
S24/E20	-	-	-	1	1	-	-	-	2
Beach Collection 1976	-	1	4	2	1	-	-	-	8

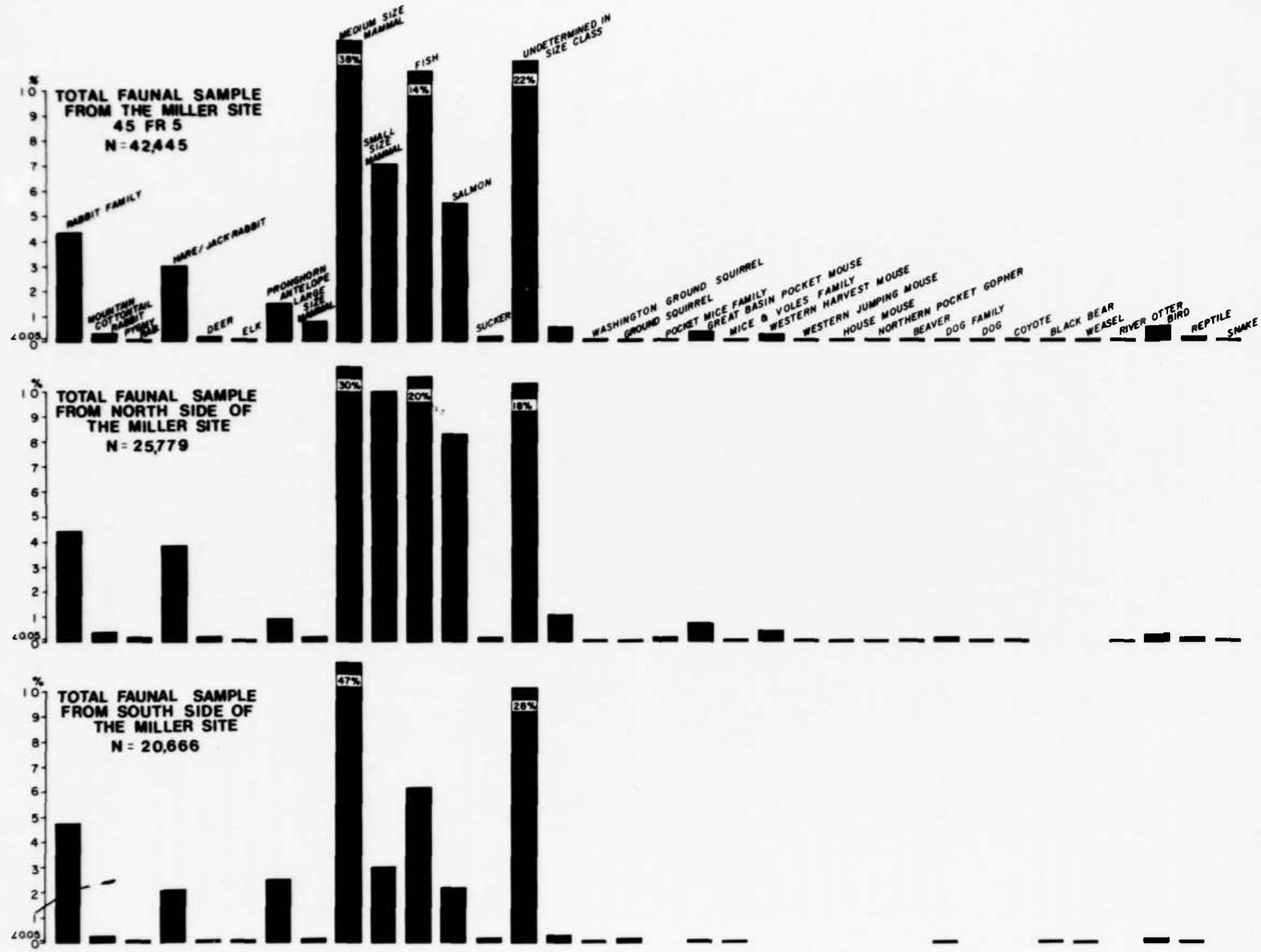

Figure 5-1. Histograms of relative frequencies of faunal items for the total faunal sample, the right bank (north side) housepit cluster and left bank (south side) housepit cluster.

Faunal items identifiable to the medium mammal body size class have the highest frequency in the composite assemblage (38%). Judging from the frequencies of medium-sized mammal bones identified to at least the genus level, most of the remains identified only to the medium body size class are probably pronghorn. A much smaller proportion are probably deer. The occurrence of pronghorn as the most frequently identified ungulate has not previously been reported in this region. Because the bones of ungulates, unlike those of most of the other animal resources, were intensively processed for bone marrow, bone grease and/or bone soup (Cleveland 1977:48), their high frequencies are somewhat deceptive. This is because ungulate bones have been fragmented to a far greater degree than the bones of other resource species.

Of the resource classes identified at least to the family level, the rabbit family dominates the assemblage in terms of element frequencies. Salmonids (salmon and trout) follow closely behind. Based upon elements identified to at least the genus level, most of the items included under "rabbit family" are probably the remains of jackrabbits; jackrabbits outnumber cottontails by a ratio of 12:1. Similarly, most of the elements identified only as "fish" or "salmonid" are probably the remains of chinook salmon (Oncorhychus tshawytscha) though some proportion may be those of sockeye salmon (O. nerka), coho salmon (O. kisutch), or steelhead trout (Salmo gairdneri). This suggestion is supported by the fact that vertebral elements of salmonidae greatly outnumber those of catostomidae (sucker family) and also by a number of otoliths found in the site all of which have been identified to be from chinook salmon. The catostomidae probably include one or more of at least four species of freshwater suckers that are native to this region: bridgelip sucker (Catostomus columbianus), largescale sucker (C. macrocheilus), mountain sucker (C. platyrhynchus), and longnose sucker (C. catostomus) (Scott and Crossman 1973:523-571).

It is assumed that most of the bird bones are from waterfowl or grouse. This is based upon the size of the remains recovered and habitat preference. A single synsacrum has been tentatively identified as grouse.

Deer bones are present in quite low frequencies and elk bones are present but uncommon. Even admitting the likelihood that the anatomy of these mammals was subjected to a greater degree of off-site butchering and culling due to heavier body weight, it seems likely that their contribution to the diet during occupations of this site was relatively small compared to that of pronghorn. No definite bison remains were identified and the few specimens identified as Bos that were recovered in the surface collection from the island shoreline are most likely remains of modern (i.e., post 1880) domestic cow. Since neither bison, nor cow, bones were recovered from any of the in situ aboriginal deposits.

The information presented in the histogram (Figure 5-1) supports the suggestion that a very few resources account for most of the faunal remains. Specifically, rabbits (particularly jackrabbits), salmonids, pronghorn, and deer in that order are probably the food resources that

contribute the vast majority of faunal elements to the composite assemblage. For this reason, discussions below focus upon these resources and their relative frequencies in various areas of the site.

Intrasite Comparisons of the Faunal Remains

As was discussed in Chapter 2, there were some notable differences in the character of surface features between the two sides of the island. It was initially anticipated on this basis that these two areas of the site would be most likely to have different faunal assemblages if any significant differences could be demonstrated within the site. Figure 5-1 shows the histograms of the frequencies of faunal items for either side of the island. There are substantially lower percentages of salmon, fish, and small mammals in the assemblage recovered from the left bank of the island when compared to that from the right bank. The left bank also has a greater relative frequency of pronghorn and this also seems to be reflected in the higher frequency of medium size mammal bones in that portion of the site. There is a slightly reduced frequency of jackrabbit on the left bank of the island and a lower frequency of small mammal bones. Before attempting to interpret any of these contrasts, it was apparent that it was necessary to determine whether differences between the two sides of the island were greater than differences within either side. It was also apparent that histograms like that used in Figure 5-1 are not too useful beyond showing the most general characteristics of faunal assemblages. A simpler way of displaying faunal assemblage "signatures" was required that would emphasize in a graphic way any intrasite differences. Faunal classes that were probably not human food resources (small rodents) and those classes that occur only rarely (e.g., bear, elk, and otter) were eliminated at this juncture in the analysis with the reasoning that relative frequencies of both would only obfuscate interesting patterning in the occurrence of faunal classes that more closely approximate being food "staples." There was also the problem of redundant information deriving from the fact that classes differing in their levels of identification duplicate one another. For example, pronghorn are represented in the species level class for this resource but also probably comprise the vast majority of specimens in the "medium mammal" class. It seemed appropriate to develop faunal indices that measure one or the other class but not both classes in instances of this kind. In short, attention focused upon a small number of resource classes that were relatively common and rather ubiquitous in their distribution throughout the site. Trial runs were carried out with various combinations of between three and six resource classes. A variety of graphic techniques for displaying differences in relative frequency were also explored, and it is appropriate here to discuss the results of these efforts.

In the analysis that follows, an "assemblage" is simply a collection of faunal items from a particular structure or area of the site, or in some cases from different depositional units in the same area of the site. An assemblage, in this sense, may or may not be a

stratigraphically and/or temporally discrete collection of items. Because archaeologists have often placed considerable emphasis on "activity areas" on and around house floors (c.f., Brauner 1976; Lyman 1976; Vent 1976), a few comments are necessary regarding the reliability or representativeness of faunal assemblages that derive in many instances from small excavation units or trenches.

There are several reasons that can be offered here in defense of our assumption that the samples being analyzed are in most instances at least broadly representative of the areas or structures from which these samples were recovered. The first is that most are "coarse-grained" assemblages (Binford 1981:20) in that they minimally reflect the processing and consumption events that occurred over intervals of several months. In many instances, the assemblages undoubtedly refer to multiple seasons of site occupation. A second factor contributing to the representativeness of the faunal assemblages is that an effort was made in the placement of many excavations to cross-cut housepit floors, walls, and midden rings. The third factor is that the number of faunal items recovered tended to be relatively high even from small excavation units. Beyond the relatively high density of faunal remains across much of the site, the actual size of several excavation units was respectable. All of these points are offered in anticipation of criticisms of the following analysis that can be expected from archaeologists who imagine that the vagaries of sampling bias associated with small excavation units preclude meaningful assemblage comparisons.

Intrasite Faunal Assemblage Variability: The DARS Index

Initially, histograms of faunal items identified at least to the family level for the various areas of the site were prepared. The analysis was limited to the resource classes accounting for most of the animal foods represented at the site: deer, pronghorn, rabbit (including *Lepus*, *Sylvilagus*, and Leporidae) and salmonid. These four resource classes are those found most extensively across the entire site and their relative frequencies will hereafter be referred to as the DARS (Deer-Antelope-Rabbit-Salmonid) Index. The histograms for all areas from which at least 25 items were so identified are shown in Figures 5-2 and 5-3. Figure 5-2 includes histograms for the right bank housepit cluster only and Figure 5-3 includes those for the left bank as well as for OA-78 on the right bank.

Examination and comparison of DARS Indices from the various areas of the site shown in these figures does not readily support a simple dichotomy between the two major clusters of housepits. What is immediately apparent is that there are substantial differences in all of these assemblages that are related primarily to differences in the relative frequencies of three resource classes: salmonids, pronghorn, and jackrabbits. Assemblages which are "rabbit dominated" occur in all four housepits located in the left bank housepit cluster--depressions 96, 117, 119, and 128. Assemblages from the right bank cluster, however, are much less uniform. Some are "rabbit dominated" (D-30,

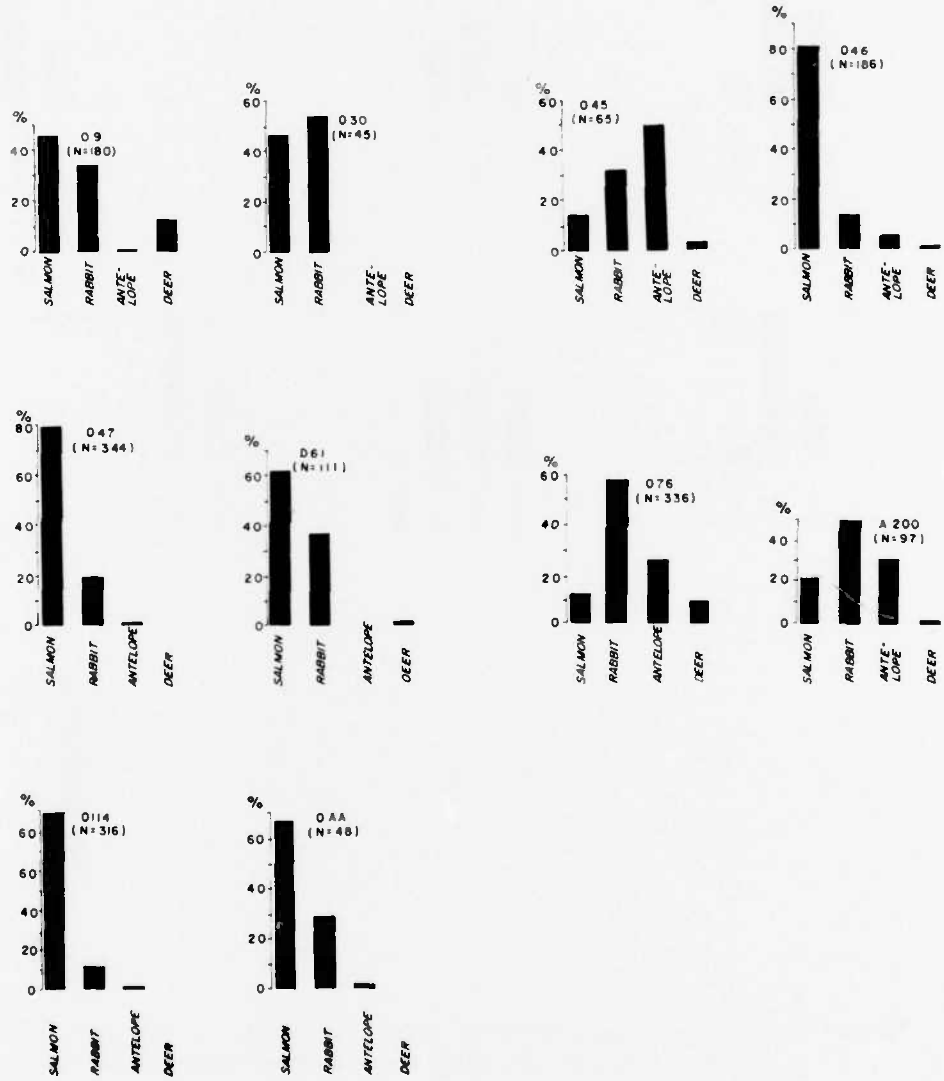

Figure 5-2. Histograms of DARS index for units in the right bank cluster.

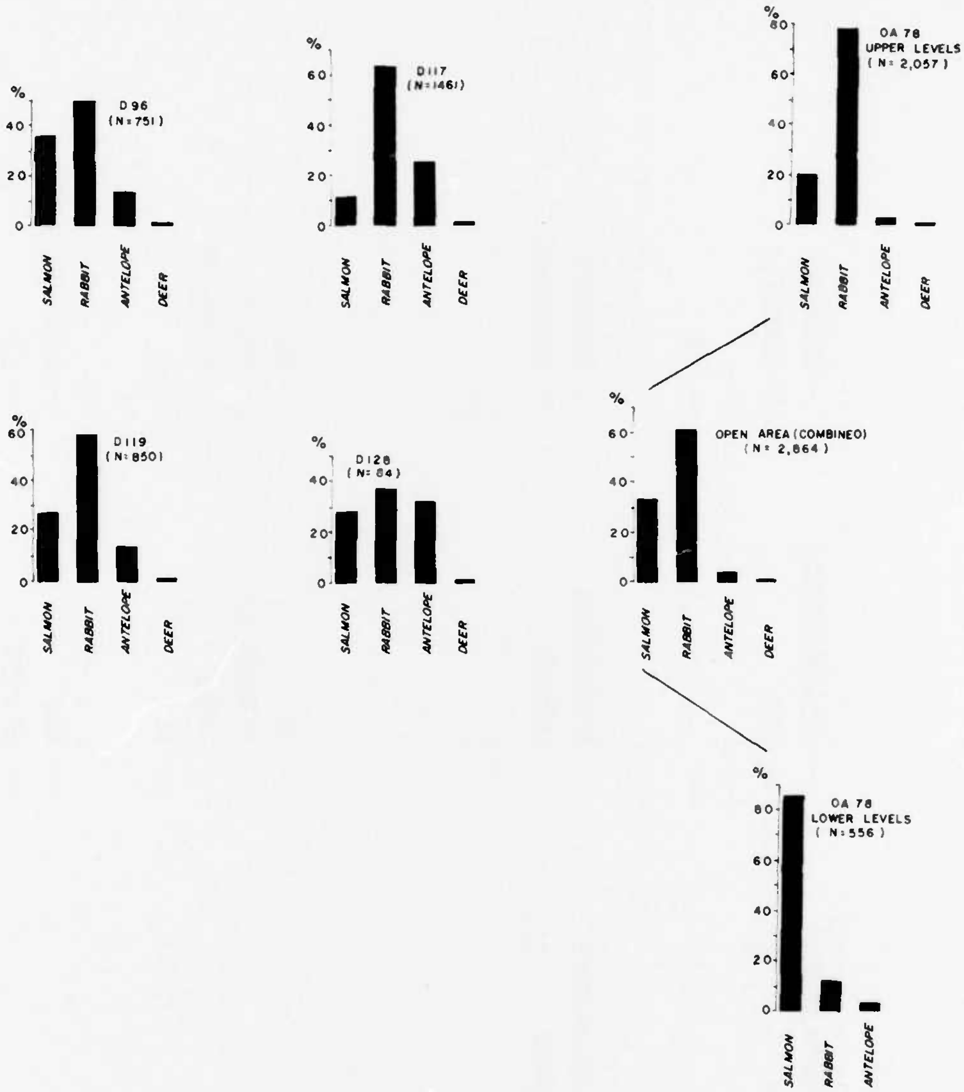

Figure 5-3. Histograms of DARS index for units in the left bank cluster and the open area (upper, lower, and composite).

D-76, OA-200, and OA-78), while a number are "salmon dominated" (D-46, D-47, D-61, D-AA, D-114, and D-9). Finally, there is one assemblage (D-45) which is dominated by pronghorn. Clearly the spatial distribution of these variable assemblages does not neatly conform to a two-fold distinction between the two housepit clusters.

Having established that there are substantial variations in the DARS faunal index across the site, the next step in the analysis involved investigation of the extent to which these differences might be temporally distributed. Given the degree of vertical mixing assumed to be characteristic of most housepit features, vertical comparisons of assemblages were initially undertaken where impacts to deposits from re-excavation/re-occupation of older structures and other sediment disturbing activities were expected to be minimal. The faunal collections from the block excavation on the right bank of the island (OA-78), seemed to be the ideal location in this respect. Moreover, the size of the samples from this area was great enough to lend a degree of confidence to any vertical patterning that might be manifested. During the later part of the 1979 excavation in this area, it was observed that there were virtually sterile levels that separated an upper cultural layer (ca. 0-50 cm depth) from a lower cultural layer (ca. 70-120 cm depth). Subsequent tabulations of lithic items (see Chapter 6) and faunal items by 10 cm levels indicated that there indeed was a significant stratigraphic separation across all of the open areas except where a housepit feature had intruded through a small portion of it. This portion (Area H) was omitted from the analysis to maximize the stratigraphic integrity of the assemblages being compared. To stratigraphically partition the collections into two assemblages, vertical transition levels (10-20 cm) with very low lithic and faunal frequencies were omitted from the analysis. This procedure insured that an intermediate zone (generally one to two 10 cm levels) in which items from the two layers had been mixed by pedestrian activity, rodents, or any number of other disturbances would not obscure possible differences in the two faunal assemblages.

The assemblages partitioned in this way were dramatically different as can be seen in comparing the histograms from the upper and lower levels of OA-78 (Figure 5-3). The upper levels are strongly rabbit dominated while the lower levels are strongly salmon dominated. These patterns are based upon relatively large numbers of identified elements from both layers: 2,057 and 556 in the upper and lower levels respectively.

If the two levels are collapsed into a single combined assemblage for OA-78, the result is still a rabbit dominated assemblage but one that is much less strongly so than the upper layer alone. A histogram of this combined assemblage from the open area is shown in Figure 5-3. It should be apparent that collapsing of the larger sample from the upper layer with a smaller one from the lower layer produces a composite assemblage most similar to the larger assemblage but nonetheless intermediate to both constituents. These insights strongly hinted at the possibility that many of the faunal collections from the housepits and other areas of the site were composite assemblages and

therefore intermediate to the upper and lower assemblages from OA-78. Recognizing this possibility, it is appropriate to consider certain stratigraphic relationships between structures across the site.

All housepits that have been investigated in the left bank housepit cluster show a basically similar pattern with respect to architecture. Each of these structures contained multiple saucer-shaped living floors or use-levels (Figure 5-4). These use-levels are characteristically rather thick and well-defined compared to those observed in most of the structures on the opposite side of the island. Most importantly, all of the housepits on the left side of the island that have been investigated (D-96, D-117, D-119, and D-128) contain faunal assemblages that are rabbit dominated in terms of the DARS faunal index.

In every surface depression on the right bank of the island that proved to be a housepit upon testing, there is good evidence that the initial structure was built with steep-sided walls (Figure 5-5). Test pit stratigraphic profiles for depressions 30, 61, 65, 76, and 67 are shown in Figure 4-6 and Appendix C. Although living floors or use levels (Mierendorf, Chapter 4) are not always well-defined in these housepits, the truncations of silt layers reveal that these structures in each case had steep-sided walls. Profiles for depressions 44, 45, 46, 47, 48, AA, and 59 are not included in this report, but each of these structures exhibited similar modes of construction. While there are interesting exceptions, the majority of faunal assemblages from the right bank housepit cluster are salmonid dominated. Housepits which contain salmonid dominated faunal assemblages include D-9, D-61, D-46, D-47, and D-AA. In addition, the lower levels of the block excavation located between housepits yielded a salmonid dominated assemblage. However, some of the housepit test units as well as some tests outside of houses on the right bank of the island did not produce salmonid dominated faunal indices. These exceptions to the broader pattern are worthy of brief consideration to determine what makes them exceptional.

Excavations during 1977 in D-76 produced a faunal assemblage dominated by rabbit. Inspection of the stratigraphic profile for this housepit indicates that there are at least two use levels that occurred well above the floor of the initial steep-walled structure (see D-76, profile: Appendix C). These subsequent use levels or living floors conform closely with those observed in all left bank housepits. That is, they appear to represent saucer-shaped house floors. On the right bank these were often superimposed upon earlier steep-walled structures through re-occupation in existing surface depressions. Radiocarbon dates from one of these saucer-shaped floors in D-76 yielded dates of 480±80 B.P. (WSU-1891) and 410±130 B.P. (WSU-1893).

In housepit D-67, a similar pattern is evident. Although the faunal sample from the test trench through this house is quite small, it is dominated by pronghorn. In the stratigraphic profile of this trench (see Appendix C), the original floor of a steep-walled structure is overlain by two thick, charcoal-rich use levels of the saucer-shaped variety.

Figure 5-4. Photographs of saucer-shaped living floors.

A. Multiple floors from D-96 south wall S58/E64-66 with Feature #2 at base

B. West wall S20/W91 Open Area B floor with charcoal and mussel shell

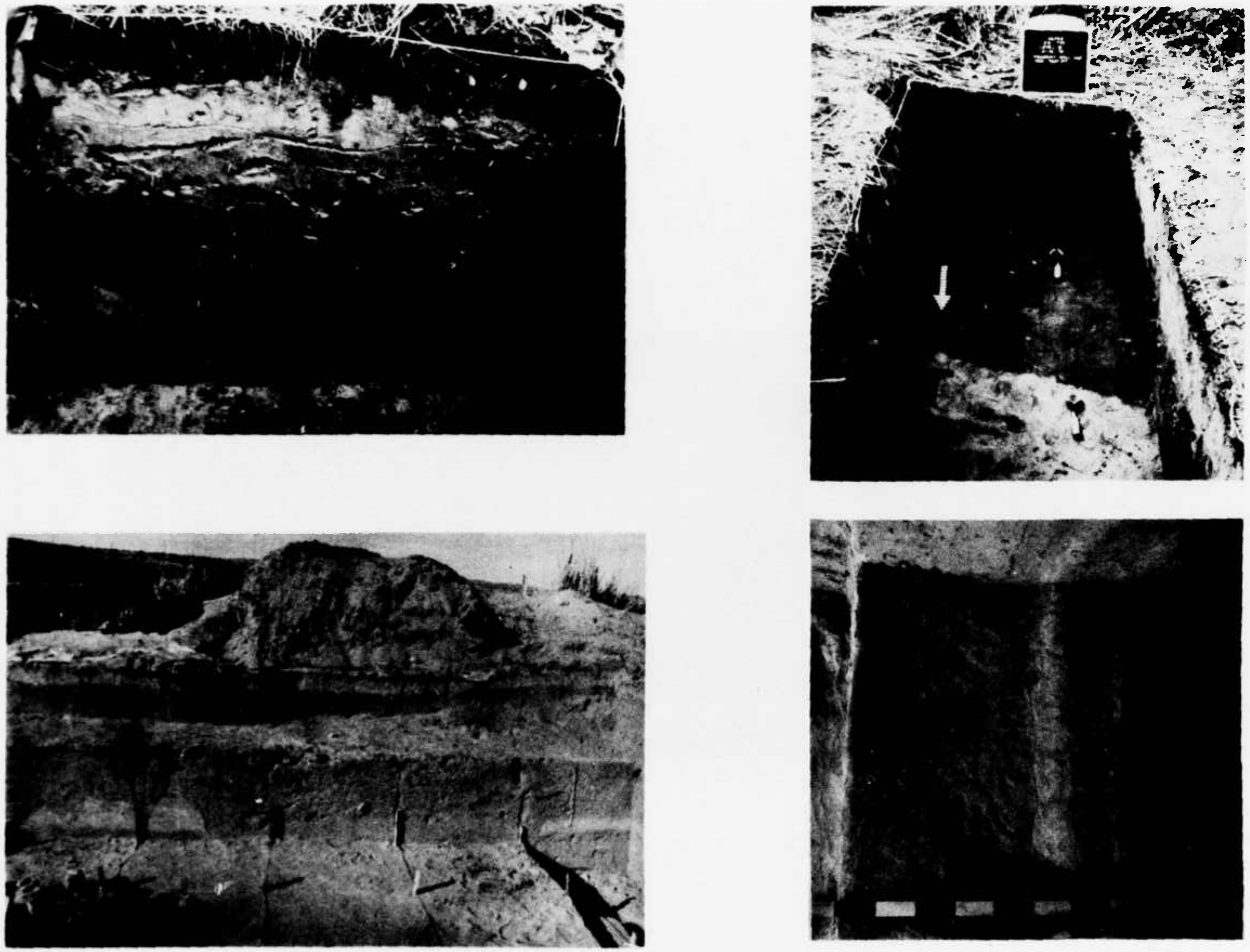

Figure 5-5. Photographs of steep-walled housepits

A. East wall of D-9

B. Housepit boundary of D-9 looking south

C. North view of D-OAH

D. Close-up of D-OAH, north view

Housepit D-30 provides the only case of a housepit that was tested on the right bank of the island which was not salmonid dominated and which showed no evidence of saucer-shaped use-levels overlying a steep-walled housepit (see D-30 profile in Appendix C). Salmonids do, however, nearly equal rabbit in identified element frequencies in this housepit faunal sample. This fact, combined with a very small sample size, may mean that this housepit would fit the general pattern if it were tested more thoroughly.

Examination of profiles for housepits D-45 and D-59 again indicates that the same pattern of later use-levels of the saucer type overlying steep-sided structures. Testing of these housepits produced faunal items that are dominated by pronghorn and rabbit, respectively, in terms of the DARS index. It should be obvious by now that there are regularities in the stratigraphic occurrence and architectural association of faunal assemblages that make some of the variability across the site seem somewhat less complicated. A more complex occupational history lies behind the variability in faunal remains from the right bank housepit cluster. One final example is in order because it provides the only evidence for the age of the earlier, steep-sided housepits.

Housepit D-9 yielded a faunal assemblage that was only weakly dominated by salmonids, and consideraton of this case will hopefully illustrate how the mixture of two or more faunal assemblage types can produce a range of intermediate "blends." Rabbit elements closely rivaled those of salmonid in the collection recovered from the test trench through this housepit. Examination of the stratigraphic profile for this depression (D-9, profile: Appendix C), indicates that the trench through this depression actually cut through the rims of two adjacent housepits--one of which was not visible from the surface. At both ends of the trench, there were sections of steep-walled housepits evident immediately above the river cobbles. Overlying the portion of the housepit intersected at the north end of the trench there were at least three occupations that conformed closely to the saucer-shaped variety of house floor. These upper occupations were also of the thicker variety described by Mierendorf (Chapter 4) for the depressions investigated on the left bank of the island. The radiocarbon assay from the floor of the steep-walled depression at the north end of the D-9 trench produced a date of 1395±80 B.P. This date is by far the earliest of the nine radiocarbon dates available for the housepit occupation of the site. Unfortunately, this date is the only one that was assayed from the steep-walled variety of housepits across the site. The eight other radiocarbon dates from the site range from 140±80 B.P. (WSU-1889) to 610±90 B.P. and all seem to be associated with the saucer-type architectural form. It is unfortunate that more samples were not submitted for dating, but by the time a correlation between house architecture and faunal assemblage had been established there was insufficient funding for more dates.

It is consistent with the occurrence of earlier housepits on the right bank that this side of the island is higher in elevation. Based upon Mierendorf's model of island deposition (Chapter 4) the right bank

became stable (with respect to frequency of inundation, erosion, and deposition by high water) earlier in time than did the left bank of the island. Thus, the right bank would be expected to provide the earliest portion of the island available for semisedentary occupation.

From all analyses to date, it appears that steep-walled houses are strongly associated with salmon dominated assemblages and the saucer-shaped houses are associated with rabbit and pronghorn dominated assemblages. Because the steep-walled house forms occurring in the earlier occupation are frequently overlain by subsequent occupations from the later occupation interval, faunal assemblages from depressions that contain residues of both intervals of occupation tend to be intermediate in terms of faunal signatures. All of the housepits investigated on the left bank of the island, however, appear to contain only occupations representing the second interval. All of these housepits (D-117, D-119, D-96, and D-128) appear to be the saucer-shaped house forms and all contain faunal assemblages dominated by rabbit.

The patterning on the right bank of the island is much more complex. Most of the depressions investigated here suggest the presence of the steep-walled house form. In depressions on this side of the island that show stratigraphic evidence for steep-walled structures only, faunal assemblages tend to be strongly salmon dominated (e.g., D-46, D-47, and D-AA). Many of the depressions on the right bank, however, also contain occupations representing both architectural forms indicated by the presence of the thicker, saucer-shaped floors overlying the steep-walled variety. This superimposed character of the occupations in the depressions on the right bank of the island seems to account for the greater variability in faunal assemblages from that area.

The Six Class Faunal Index

For a number of reasons, a second and somewhat different faunal index based upon the number of identified specimens was developed. This index included six resource classes: pronghorn, jackrabbit, cottontail, bird, salmonid, and deer. One reason for employing a slightly different and more exhaustive faunal index was to provide an independent check on the results obtained using the simpler, four-resource DARS index. A second reason was that it was suspected that meaningful information (e.g., indications of climatic change) on the relative frequencies of jackrabbit and cottontail might be obscured when all elements identifiable to the Leporidae family, the genus *Lepus* or *Sylvilagus* were collapsed as was done in the DARS index. A similar interest in how frequencies of bird and deer might alter patterns obtained with the DARS index motivated the inclusion of these resources in the six-resource index.

Experimentation with a variety of techniques for graphic presentation led to the selection of "wind rose" diagrams for displaying relative frequencies of identified faunal specimens. Use of these

diagrams offered a simple procedure for the visual recognition of faunal assemblage patterning and similar diagrams have been effectively used in the analysis of stone tool assemblages of the French Paleolithic (Rigaud 1978). The "wind rose" diagrams developed for the six faunal resource classes required plotting of frequency percentages of identified specimens along six radians on polar graph paper. Figures 5-6 and 5-7 show these rose diagrams for the same areas of the site treated in the DARS index in the preceding section. Resource classes which approximate or exceed 50% of the NISP are designated with an arrow to indicate the dominance of a resource class. These diagrams warrant further examination as well as comparison with the DARS indices.

Four kinds of assemblages may be distinguished in these diagrams and, as was observed with the DARS indices, this variability derives primarily from differences in the importance of essentially the same three resource classes: salmonids, jackrabbit, and pronghorn. These four kinds of assemblages may be listed as follows:

1. Salmonid dominated assemblages. There are five housepits or depressions (9, 46, 47, 61, and AA), a test unit that dissected two probable storage pits (D-114), and the lower occupation zone of an interhouse area (OA-78) which yielded salmonid dominated assemblages. These assemblages are characterized by the occurrence of salmonid remains with frequencies greater than 50%. In actuality, six of the seven assemblages included here have salmonid frequencies in excess of 80%. Depression 9 has a salmonid frequency of 57% and it is probably significant that this depression had clear evidence of both architectural forms and multiple occupations or use levels. With the exception of this one assemblage, this group of assemblages is notable for its lack of diversity. It is also noteworthy that all of these assemblages derive from the right bank housepit cluster.

2. Jackrabbit dominated assemblages. There are four assemblages in which jackrabbit remains approximate or exceed 50% of the elements identifiable to one of the six resources employed in this index. One assemblage is from a housepit in the left bank housepit cluster (D-96), two are from housepits in the right bank cluster (D-30, D-76), and one from the upper levels of an interhouse block excavation (OA-78). Compared to the first group of assemblages, these are somewhat more diverse in that other resources (especially salmonids and pronghorn) are reasonably well represented. In three of the four assemblages included here, salmonids occur with frequencies greater than 30%.

3. Pronghorn dominated assemblages. There are two assemblages in which pronghorn remains approximate or exceed 50% of the identified elements. One is a right bank housepit (D-45) and the other a surface collection obtained from the island shoreline ("Beach Collection"; Cleveland et al. 1977:13-14). In terms of the equitability with which other subdominant

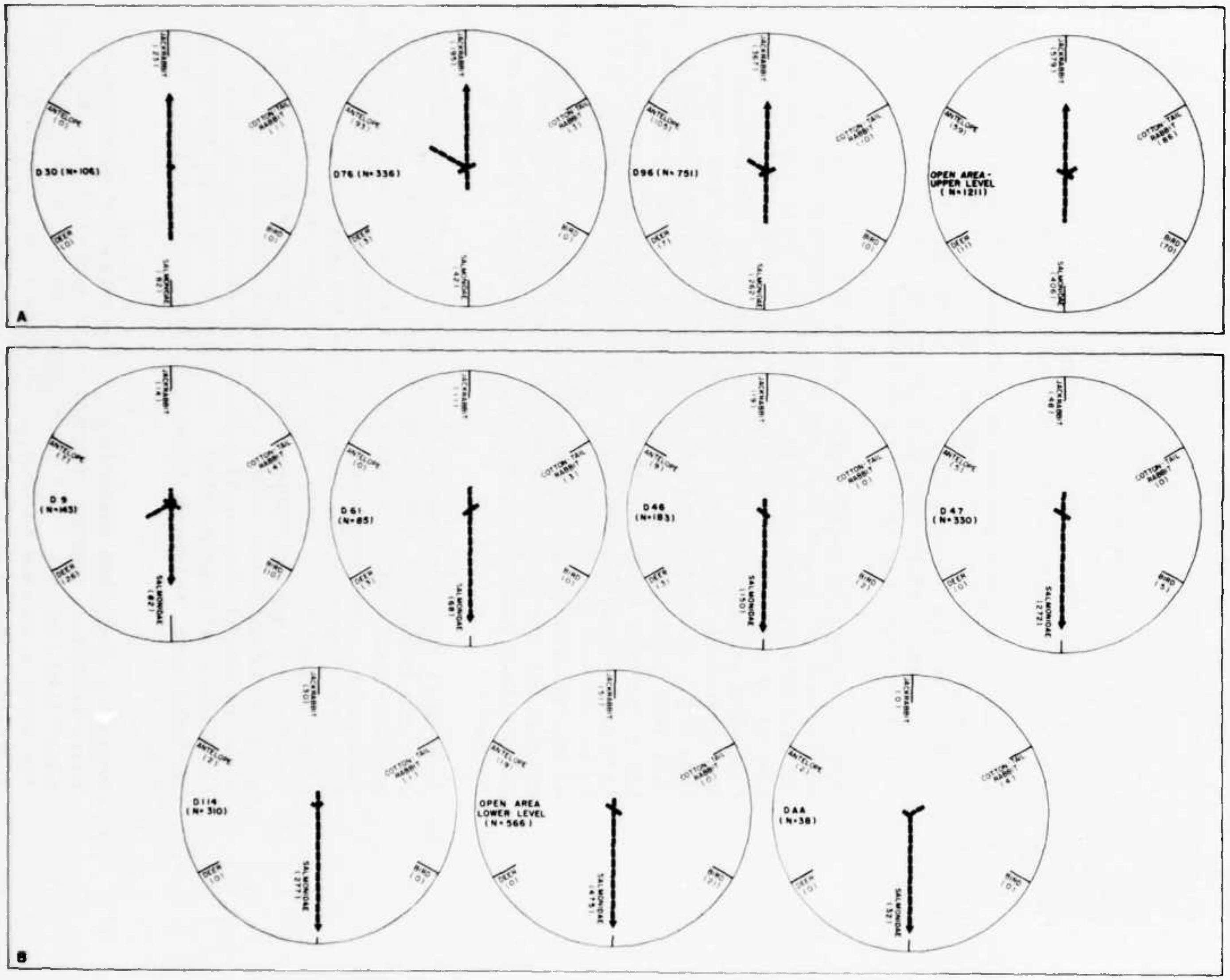

Figure 5-6. Six-resource class "wind rose" diagrams of jackrabbit dominated assemblages (A) and salmonid dominated assemblages (B).

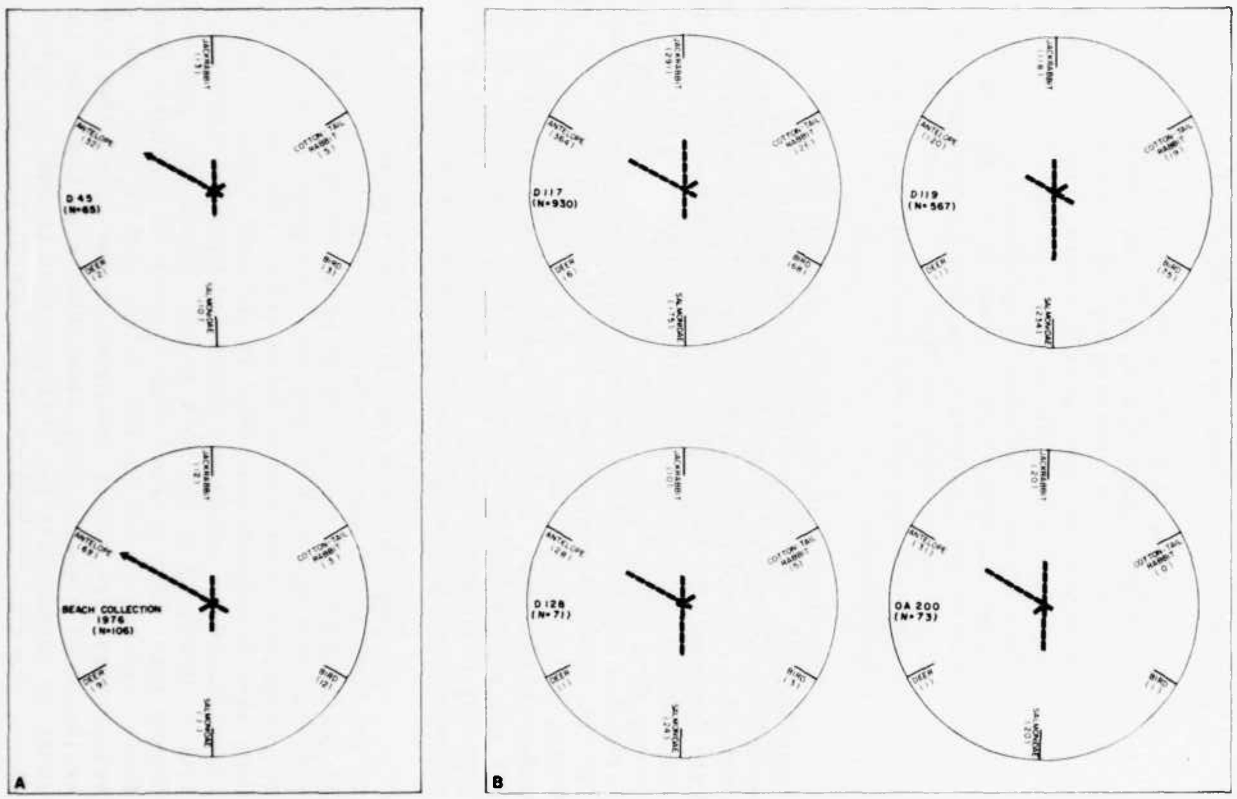

Figure 5-7. Six-resource class "wind rose" diagrams of pronghorn dominated assemblages (A) and assemblages lacking a strongly dominant resource class (B).

resource classes are represented, the D-45 housepit assemblage is relatively equitable and the Beach Collection considerably less so. In all probability, the latter assemblage has been biased by size discrimination relating to the way it was collected (without screening) as well as water action or sorting. The occurrence of Bos elements in this sample is further indication that it may be of low integrity.

4. Assemblages lacking a strongly dominant resource class. There are four assemblages in which no resource class is represented by frequencies approaching 50%. These assemblages include an interhouse or open-area excavation from the right bank (OA-200) and three housepits on the left bank (D-117, D-119, D-128). The most commonly occurring resource is pronghorn in three of these assemblages and salmonids in the fourth. In terms of diversity, however, these four assemblages are the most diverse of all those shown in Figure 5-7. Jackrabbit, pronghorn, and salmonids are well represented in all four of these assemblages.

Depending upon the sample sizes from assemblages associated with steep-walled, and saucer-floored house structures, we would expect assemblages deriving from housepits with superimposed structures to exhibit a range of faunal "blends". While the patterns evident in the rose diagrams are suggestive in this regard, we do not know in most cases enough about the constituent assemblages that have been "blended" to say much about this. It is, however, interesting to note that the six-class index seems to indicate a higher degree of resource diversity for the housepits on the left bank of the island. Housepits D-117, D-119, and D-128 are from that area of the site and all fall in the undominated group. Recognizing that assemblages from these housepits are all associated with saucer floored structures, it is not clear why they are not more strongly dominated by jackrabbit or pronghorn or why salmonids are so strongly represented in each.

In comparing the patterning observable with the six-class index to the DARS index, there is relatively good correspondence. All seven of the assemblages recognized as salmonid dominated with the DARS index are also distinguishable with the six-class index. Two assemblages can be recognized as pronghorn dominated in the six-class index, and these were also pronghorn dominated in the DARS index. Three assemblages identifiable as jackrabbit dominated with the six-class index were also rabbit dominated in the DARS index. There are, however, four assemblages which shifted with respect to dominance between the two faunal indices (D-117, D-119, D-128, and OA-200). All of these assemblages were rabbit dominated in the DARS index and it is clear that exclusion of elements only identifiable as Leporidae in the six-class index is responsible for this apparent change in faunal signatures. In short, the four assemblages that were distinguished by the lack of a strongly dominant resource in the six-class index were all at least weakly dominated by rabbit in the DARS index.

In general then, the differences in the way the two faunal indices discriminate assemblages are quite minor. Differences that do exist derive mainly from the use of a generalized "rabbit" class in the DARS index as opposed to the use of only genus-level identifications for jackrabbit and cottontail in the six-class index. Both indices demonstrate that the assemblages deriving from the right bank housepit cluster are more variable than those from the left bank. A major difference between these two areas of the site is that salmonid dominated assemblages only occur on the right side of the island.

It can be emphasized again that the major dimensions of variability in all the faunal assemblages being discussed derive from differences in the frequencies of only three resource classes--rabbit, pronghorn, and salmonids. In terms of the association between faunal signatures and architectural forms, the salmonid dominated assemblages are strongly associated with steep-walled structures. The saucer-floored structure form may be associated either with assemblages that are dominated by rabbit or pronghorn. A range of assemblages that are intermediate in character appear to be generated by the superpositioning of the latter house form within the depressions of the earlier steep-walled structure in several areas of the right bank housepit cluster.

The rose diagrams indicate that the salmonid dominated assemblages tend to be much less diverse than those dominated by either pronghorn or rabbit. It appears that the steep-walled structures are associated with the low diversity, salmonid dominated faunal assemblages, and this point will be returned to in Chapter 7.

The Small Mammal-Medium Mammal-Fish (SMF) Index

A third faunal index was developed that is based upon the relative frequencies of those elements that could only be identified to one of three classes: small mammal, medium mammal, and fish. Judging from all other faunal evidence discussed to this point, it is reasonable to state that most elements identified as small mammals are the remains of rabbit (especially jackrabbit); most elements identified as medium mammals are the remains of pronghorn; and most elements identified as "fish" are remains of salmonids. This argument implies that the very large number of elements or items typically not identifiable beyond these very gross levels can actually be linked directly to specific resource classes at the genus or species level. Comparisons of element frequencies based upon the small mammal, medium mammal, fish triad offered a means for discriminating assemblages that was quite independent from the other indices.

A number of small test pit units are included in this analysis with the assumption that this index would be particularly effective at discriminating different kinds of faunal assemblages in small samples. By including a number of 1 m x 1 m test units, horizontal dispersion of samples across the site was greatly increased as well.

Relative frequencies of elements identified to one of the three classes were plotted on a ternary diagram illustrated in Figure 5-8. Two observations stand out immediately in an examination of this figure.

The first is that there are no assemblages characterized by high frequencies of small mammal elements despite that fact that the other faunal indices discriminated several rabbit dominated assemblages. The significant dimension of variability in this index is clearly the relative frequencies of fish and medium mammals. This pattern is probably a function of the high degree of bone breakage in the case of the medium mammals combined with the larger size of their bones. Pronghorn and deer bones were subjected to severe fragmentation--presumably during intensive processing for marrow, bone grease, or bone soup. Although the long bones of rabbits are typically broken and were no doubt a source of bone marrow, the skeletons of these small mammals were not reduced to the same degree as those of the medium mammals. Consequently, higher degrees of identifiability are probably achieved for rabbit compared to the larger mammals.

The second readily observable pattern evident in Figure 5-8 is that there are two major groupings of assemblages--one that is characterized by high frequencies of medium-sized mammal elements and the other by high frequencies of fish elements. It is necessary at this point to examine how these groupings of faunal assemblages compare to those generated by the previous two faunal indices.

With respect to discriminating those assemblages dominated by salmonids, the correspondence between this index and the other two is quite good. With the exception of D-9 all of the excavation areas that were identified as salmonid dominated by the previous indices are high fish frequency assemblages with this index. Depression 9 may be exceptional in that it appears to have had at least three episodes of re-occupation and the test trench through it appears to have intersected two adjacent housepits (Appendix C: D-9 profile). It is, therefore, a relatively coarse-grained assemblage. All of the assemblages included in the high fish-element frequency cluster of Figure 5-8 are located on the right bank of the island where the steep-walled structures occur. In addition, the lower levels of the OA-78 block excavation on the right bank is included in this group of assemblages, and again this is consistent with expectations based upon the previous faunal indices.

One assemblage, D-30, falls within the high fish element frequency cluster of Figure 5-8 and was not identified as salmonid dominated in the previous analyses. This housepit produced a rabbit dominated assemblage in terms of the DARS and six-class indices, but salmonid elements were nearly as numerous as rabbit elements. The reduction in importance of small mammals in this index, for reasons discussed above, accentuates the similarity of this assemblage to others that are more strongly salmonid dominated.

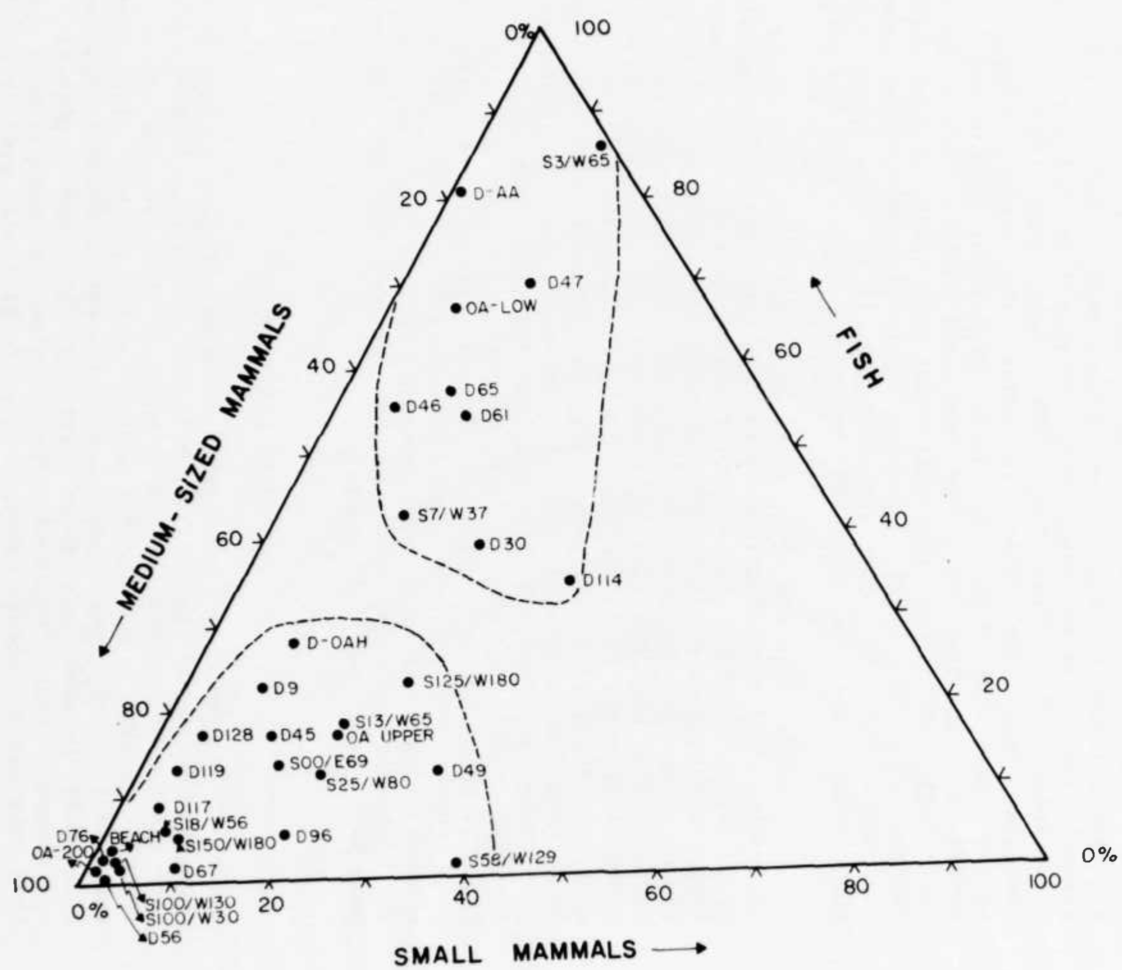

Figure 5-8. Ternary diagram showing the Small Mammal-Medium Mammal-Fish faunal index.

Anatomical Part Frequencies of the Ungulate Fauna

The present study did not undertake a systematic analysis of anatomical part frequencies. Such analysis would, however, be informative and hopefully will be accomplished in the near future. For the present, a few general impressions are worth presenting.

Pronghorn remains recovered in the site include all parts of the skeleton but some parts are strongly underrepresented. Vertebral elements and pelves are uncommon in the faunal assemblages from the site (Cleveland et al. 1977:45; Olson 1983). Large quantities of tiny cancellous bone fragments seem to indicate that these portions of the skeleton were largely destroyed in the process of bone grease production. The presence of numerous skull parts as well as lower limb parts indicates that pronghorn carcasses were typically transported to the site in their entirety. Despite the small size of these animals and the potential for transport in watercraft, it is probably the case that these animals were not killed at any great distance from the site.

The deer and elk remains, on the other hand, present an interesting and quite distinctive pattern. Most are either skull parts or lower leg elements. Given that these animals are large enough that they would require field butchering to produce portable meat packages and given an interpretation of this site as a residential base, it is expected that high meat utility elements of these animals should be most frequent in the site collections. Just the opposite pattern is observed; those parts of low utility that would ordinarily be expected to be abandoned or culled at a kill site are present in high frequencies at Strawberry Island. A plausible interpretation that can be offered for this apparent paradox is that the deer and elk remains did not enter the site along a logistic pathway between kill site and residential site. Rather, they were probably scavenged from predator kills or natural death sites at which nonhuman carnivores had already consumed the high value segments of the carcass (Binford 1981 for a discussion of body parts scavenged by hominids).

Pronghorn Utilization

Pronghorn elements constitute the vast majority (92%) of all ungulate remains identified in the faunal collections from the site. When other faunal assemblages from sites of this type and age are reported, a similar pattern may emerge for the region. Given that the Pasco Basin is the most arid region of the entire Columbia Plateau, high frequencies of pronghorn can be partially attributed to general environmental characteristics. The situation is somewhat more complex than this though because housepit sites in basically similar settings within this same general area have yielded faunal assemblages in which deer outnumber pronghorn. The Umatilla site faunal remains, for example, contained deer in higher frequencies than pronghorn (Schalk 1980). At least two possibilities may be involved here.

The first is that climatic changes during the past 2,000 years have been of sufficient magnitude to significantly shift the relative abundance of deer and pronghorn available in the Pasco Basin region at different periods. Given an average annual precipitation of 7 inches in the area today and the low relief for considerable distances in all directions from this central portion of the basin, it is not difficult to envision major faunal changes resulting from even minor changes in annual precipitation. There is now reason to believe that the interval during which occupations occur at Strawberry Island was indeed one in which conditions were generally dryer than those of today. This subject will be discussed at greater length in Chapter 7. It should be recognized that the regulation of ungulate populations in this region would be very strongly linked to fluctuations in precipitation and that profound changes may have occurred with relatively short cycle droughts. If so, we can expect that future studies of housepit faunal assemblages in the vicinity of the Columbia-Snake confluence will yield quite different faunal assemblages even from sites separated in age by only decades. The fact that deer are not more abundant than pronghorn in any of the assemblages at Strawberry Island may simply indicate that this site was only occupied during periods of drought or relatively dry conditions. There is no reason to assume that the site was continuously occupied throughout the time span covered by the radiocarbon dates and, in fact, this seems unlikely. Unknown resource distributional factors may well have operated in a way that use of this island as a residential location was only advantageous during relatively dry periods. This point partially anticipates a second possible explanation for the high frequency of pronghorn at the site.

Exploitation of pronghorn was probably not done on an individual basis but rather by means of communal game drives. This interpretation is supported by Cleveland's analysis (1978:37) which indicated that the age structure of pronghorn represented at the site was not consistent with that expected for hunting of individual animals. Another line of evidence favoring communal pronghorn drives has to do with the season at which many of the pronghorn were apparently killed. In his analysis of the pronghorn mandibles, Cleveland (1978:37) noted that several specimens were an estimated 6-8 months of age. This seems to imply late fall/early winter hunting (Cleveland 1978:37) and it is at that time when pronghorn tend to be aggregated into the largest herds of the annual cycle (Einarsen 1948:51). A third line of evidence supportive of the communal pronghorn drive interpretation is the impression that individual houses or features within houses yield anatomical parts representing virtually all portions of the skeleton. Assuming, as we do, that pronghorn and other mammalian resources were strictly a minor supplement to a winter season diet deriving primarily from stored resources, introduction of fresh meat in the form of mass kills would probably result in the distribution of whole animals to individual household units. This pattern of distribution contrasts with that expected when individual animals are introduced to a residential site. If individual animals were being introduced (as might be expected to result for the efforts of a single hunter), some form of distribution of portions of the carcass between households would be expected. Binford (1978:472) suggests that social relationships between households are

reflected in patterned distribution of specific meat units under such circumstances. It is interesting in this regard that the sort of pattern expectable with introduction of single animals has been described for deer remains in housepits excavated at Alpowa (Lyman 1976:129). This archaeological occurrence fits well with the encounter strategy for taking one or a few individuals that presumably was employed in hunting these animals.

There is another argument for the interpretation that large numbers of pronghorn were taken in relatively rare episodes of communal hunting. Faunal assemblages associated with the saucer-floored housepits in the site vary between those that are rabbit dominated and those that are pronghorn dominated. Assuming the liklihood that jackrabbits were also taken in large numbers during occasional or even infrequent drives, alternating dominance of faunal assemblages from individual occupations at residential sites would be a predictable consequence. Given probable population fluctuations in both of these resources, the simultaneous occurrence of high population levels for pronghorn and jackrabbit in any given year would probably be unusual. Since the two resources would not necessarily be expected to cycle synchronously in abundance, faunal assemblages deriving from individual occupation episodes would oscillate with respect to frequencies of these two resources. These expectations match well with variability in the faunal assemblages that has been discussed in earlier sections of this chapter.

The pronghorn has a number of unusual behavioral characteristics that condition the ways in which they can be hunted. On the one hand, their keen eyesight, fleetness of foot, and preference for open country are all qualities that provide protection from predation (Einarsen 1948). On the other hand, they tend to aggregate into very large winter herds, are unwilling to jump even low barriers, and occupy relatively small home ranges (Wormer 1969)--all qualities that make them vulnerable to human hunting techniques for mass harvest. It is therefore, not surprising that historic accounts of Indian hunting of pronghorn indicate the importance of game drives, pounds, or pens (Einarsen 1948:7; Wormer 1969:154; Steward 1938). Given too that a mature male pronghorn yields only about 30 pounds of edible meat (Einarsen 1948:47), it is apparent that hunting of singular animals would not, under many circumstances, be a cost-effective economic pursuit with respect to pronghorn. The point to be emphasized is that there are several reasons for suggesting that the pronghorn represented in the Strawberry Island faunal collections were generally taken in mass harvest events. Such events may have occurred intermittently and not necessarily on an annual basis.

To return to the earlier suggestion that occupation of this site may have occurred during especially dry intervals when pronghorn were of particular importance, it may be noteworthy that numerous large sand dunes occur immediately to the north of the Snake in the vicinity of the site today. Whether or not these dunes actually were used with some kind of trapping strategy is uncertain, but natural terrain features probably would have been exploited to maximum advantage in construction

of traps. Whatever the specific strategy, however, the purpose here is to suggest that the occurrence of pronghorn as the strongly dominant ungulate in the faunal assemblages from this site can be explained without ignoring the fact that other late prehistoric housepit sites in this same region yield assemblages with deer as the most common ungulate. The faunal resources in this region, would have been responsive and perhaps dramatically responsive to even minor and relatively short-term changes in annual precipitation. Subsistence strategies as well as site locational strategies can reasonably be expected, in turn, to closely track changes in faunal resources.

The Catostomidae

The various species of the sucker family which are native to the Snake River are all late spring/early summer spawners (Scott and Crossman 1973). Riparian habitats preferred for spawning by the different species of sucker vary enough that without identifications to the specific level, it is not possible to say much about how or where these fish might have been exploited. Suckers do aggregate and undertake limited upstream migrations during the spawning season. Exploitation of these fish, therefore, would probably have been most effective during the spring of the year. This would imply that intrasite distribution of sucker remains might be an indicator of season of occupation. Faunal assemblages including remains of sucker might then be interpreted as evidence for occupation during the spring or early summer.

Examination of the frequencies of sucker bones compared to all others from the various areas of the site (Table 5-1) produced ambiguous results in this respect. The ratios of sucker to salmon remains or to all other faunal items are quite variable across the site and show no clear patterning related to differences in house architecture or frequency variations in the occurrence of other faunal classes. The absolute frequencies of sucker bones are uniformly low in all areas (no single excavation unit yielded more than six bones identifiable as sucker) and, along with an apparent lack of patterning between various occupations or areas of the site, this seems to imply one of two possibilities: 1) that any economic changes that occurred between the different intervals of occupation represented at the site did not involve any substantial change in patterns of usage or degree of use of these fish, or 2) that nonhuman agents are responsible for many of the sucker remains occurring across the site.

Avian and mammalian predators and scavengers represent one mechanism for introduction of sucker remains into the site deposits. Another possible mechanism for nonhuman introduction into the site deposits would be deposition of sucker remains during floods that inundated the islands at various times in the past centuries. The housepit depressions themselves might have entrapped these fish as the flood waters receded. It is, in any case, difficult to make any conclusive statements about the use of suckers from information available on their distribution in the site.

Chapter Summary

A faunal sample of 51,322 individual bone items has been analyzed in this study. This sample represents about 80 percent of all the faunal remains recovered by Washington State University between 1976 and 1979, during the course of an intensive testing project. The sample analyzed leaves much to be desired when one considers the size and complexity of the site but relative to other faunal collections that have been analyzed and reported in the Columbia Plateau, it is unequalled.

A small range of faunal resources account for the vast majority of identified elements of economic fauna. Rabbit, pronghorn, and salmonid elements eclipsed those identified for all other resource classes. Without considering here the complicated question of absolute importance of the various resource classes in subsistence, it is probably accurate to state that these three resources represent the animal foods of greatest quantitative importance in the diet of the people who occupied this site during the period of the year that they lived on the island. The relative importance of these three resource classes to one another is probably not reflected in any simple way by identified elements and this subject was not one that was given particular attention in this analysis. To do so would require thorough consideration of the ways in which bone processing, differential preservation, and different degrees of identifiability influence measures like NISP or MNI. Obviously, meat weight conversions would also have to be made if one were to attempt to establish a common currency for comparing the relative or absolute importance of individual resources.

The thrust of this analysis was to develop faunal measures for approaching questions pertaining to site structure. Surficially visible structural remains provided the initial basis for posing questions regarding intrasite assemblage variability. To this end, three different faunal indices based upon numbers of identified elements were developed.

By utilizing these faunal indices it was demonstrated that there were indeed differences in the faunal assemblages from the two housepit clusters and that two distinctive architectural forms exhibited rather consistent differences in their associated faunal assemblages. The left bank housepit cluster appears to have been rather exclusively composed of houses that are characterized by saucer-shaped floors. House forms of this variety are associated with faunal assemblages dominated by rabbit and/or pronghorn. The right bank housepit cluster yielded a more complex array of faunal assemblages. In this portion of the site, saucer-floored houses were frequently stratigraphically superior to and generally directly superimposed on the steep-walled architectural form. This second house type is strongly correlated with salmonid dominated faunal assemblages. Because faunal assemblages from individual housepits were dealt with as aggregates, superimposition of later occupations (saucer-floored houses) on earlier housepits produced

varying faunal "blends." In essence, the faunal indices gave insights to site structure that had gone largely unappreciated during the course of fieldwork.

To our knowledge, this is the first demonstration in the Plateau of a recurrent association between architectural forms and faunal assemblages. It is also the first reported occurrence on the Columbia Plateau of a late prehistoric residential site in which pronghorn is the dominant ungulate in a faunal assemblage. These points and various implications are discussed at greater length in the concluding chapter.

REFERENCES CITED

Binford, Lewis R.
1978 Nunamiut Ethnoarchaeology. Academic Press, New York.

1981 Bones: Ancient Men and Modern Myths. Academic Press. New York.

Brauner, David R.
1976 Alpowai: The Culture History of the Alpowa Locality (Vol. I-II). Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University.

Cleveland, Gregory C.
1977 Experimental Replication of Butchered Artiodactyla Bone with Special Reference to Archaeological Feature at 45FR5. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village Near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 46.

1978 Some Inferences About Patterned Behavioral Activities Influencing the Distribution of Artifacts and Their Soil Matrices. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington. Washington Archaeological Research Center, Project Report Number 72.

Einarsen, A. S.
1948 The Pronghorn Antelope and Its Management. The Wildlife Management Institute. Washington, D. C.

Gustafson, Carl E.
1972 Faunal Remains from the Marmes Rockshelter and Related Archaeological Site in the Columbia Basin. Unpublished Ph.D. dissertation, Washington State University, Pullman.

Harkins, Stanley K.
1980 The Prehistoric Occurrence and Aboriginal Utilization of Bison in the Central Columbia Basin, Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Kenaston, Monte Ray
1966 The Archaeology of the Harder Site, Franklin County, Washington. Laboratory of Anthropology, Washington State University, Reports of Investigations Number 35.

Lyman, Richard Lee
1976 A Cultural Analysis of Faunal Remains from the Alpowa Locality. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Olson, Deborah
1980 Faunal Remains, Appendix F. In Cultural Resource Investigations for the Second Powerhouse Project at McNary Dam near Umatilla, Oregon, assembled by R. F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Report Number 1.

1983 A Descriptive Analysis of the Faunal Remains from the Miller Site, Franklin County, Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Osborne, Douglas
1957 Excavations in the McNary Reservoir Basin near Umatilla, Oregon. Bureau of American Ethnology Bulletin 166, River Basin Surveys Paper 8:1-258.

Rigaud, Jean-Philippe
1978 The Significance of Variability Among Lithic Artifacts: A Specific Case from Southwestern France. Journal of Anthropological Research 34(3):299-310.

Schalk, Randall
1980 Results of the Archaeological Survey and Testing: Prehistoric. In Cultural Resource Investigations for the Second Powerhouse Project at McNary Dam, near Umatilla, Oregon, assembled by R. F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Report Number 1.

Scott, W. B. and E. J. Crossman
1973 Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184. Ottawa.

Shiner, Joel L.
1961 The McNary Reservoir: A Study in Plateau Archaeology. Bureau of American Ethnology, Bulletin 179, River Basin Surveys 23:149-266. Washington, D.C.

Steward Julian H.
1938 Basin-Plateau Aboriginal Socio-Political Groups. Bureau of American Ethnology Bulletin 120. Washington, D.C.

Uerpmann, Hans-Peter
1973 Animal Bone Finds and Economic Archaeology: A Critical Study of "Osteo-Archaeological" Method. World Archaeology 4(3):307-322.

Wormer, Joe Van
1969 The World of the pronghorn. J.B. Lippincott Company, Philadelphia and New York.

Yent, Martha E.
1976 The Cultural Sequence of Wawawai (45WT39), Lower Snake River Region, Southeastern Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Ziegler, Allan C.
1965 The Role of Faunal Remains in Archaeological Investigations. In Symposium on Central California Archaeology, edited by F. Curtis, Sacramento Anthropological Society Papers, Vol. 3, pp. 47-75.

1973 Inferences from Prehistoric Faunal Remains, An Addison-Wesley Module in Anthropology No. 43. Reading, MA

CHAPTER 6

A BRIEF CONSIDERATION OF THE LITHIC ASSEMBLAGES

by

Randall F. Schalk

The primary focus of most of the lithic analyses performed to date on the Strawberry Island data has been upon replication and lithic reduction sequences. The results of these efforts were reported in the annual reports for the 1976 and 1977 seasons (Flenniken 1977; 1978). Analysis of lithic items recovered during the 1978 and 1979 seasons continued along similar lines. Greater attention was directed towards generation of quantitative data on the way in which stone tools were produced through examination of the various debitage by-products. In addition, raw material types were identified for each lithic item. Tools however, were subjected to only limited scrutiny beyond preliminary classification. Tabular data on debitage classes, raw material types, and stone tools by excavation unit are presented in Table 6-1. These data were assembled by J. Jeffrey Flenniken for the 1978 collections and by Robert Wilkinson with Flenniken's guidance for the 1979 collections. The discussion of lithics presented here briefly summarizes major results of the efforts by Flenniken (1977; 1978) and Wilkinson (n.d.) and touches upon a number of additional and salient characteristics of the lithic materials. It is regrettable that the insights gained from the faunal assemblages and the stratigraphic analysis could not, at this time, be more fully evaluated with respect to lithic assemblage variability. Such an effort stands out as a high priority in future study of the collections from Strawberry Island.

The analyses that have been accomplished indicate that the entire lithic reduction sequence is well represented at the site. This was inferred from the frequencies of decortication flakes and shatter with cortex (Flenniken 1977:75). Along with the widespread occurrence of incipient cone cortex on lithic debitage, the presence of these by-products seems to indicate that most of the raw materials were acquired from a nearby alluvial source--probably the river gravels in the immediate vicinity of the island (Flenniken 1978:91). It was noted that cobble tools constituted a substantial proportion of the lithic assemblage and that "cobble choppers," in particular, constituted nearly 70% of all of the tools based on cobbles (Flenniken 1977). Experiments involving the butchering of pronghorn with stone tools supported an interpretation of the cobble spall tools, choppers, and large pecked cobbles or "anvil stones," as a tool-kit associated with the breakage and processing of bones for marrow and bone grease (Flenniken 1977:101). Wear patterns on the experimental tools approximated those evident on the archaeological specimens. Indeed, these three cobble tool classes were frequently found in association with each other and with highly fragmented mammal bone.

Table 6-1. Basic lithic data by excavation unit: debitage, tool, and raw material counts.

Excavation Area	Debitage Lithic Technological Classes										Stone Tool Classes												Raw Material Classes								
	Bipolar Cores	Direct Percussion Cores	Undiagnostic	Bipolar	Primary Decortication	Secondary Decortication	Thinning	Shatter	Potlids	Debitage Total	Biface Fragment	Arrow Point Preforms	Arrow Points	Knife Preforms	Knives	Choppers	Chopper Fragments	Ovate Flake Tools	Utilized Flakes (Basalt)	Utilized Flakes (Chert)	Hammerstones	Pestles	Basalt	Chert	Quartzite	Silicified Wood	Chalcedony	Opal	Jasper	Obsidian/Ignimbrite	Granite
D-9[2/]	11	14	133	74	5	14	58	41	4	345	3	3	3	1	1	6	4	1	5	1	1	1	388	153	39	19	58	9	27	2	12
D-30[1/]	44	6	52	69	4	14	71	56	-	316	-	2	6	-	-	11	-	1	-	-	-	-	469	103	98	12	126	47	35	-	11
D-44	2	-	7	1	1	3	-	-	-	14	-	-	-	-	-	2	-	-	-	-	-	-	8	6	1	-	-	-	1	-	-
D-45[3/]	6	1	45	9	4	8	5	3	-	81	-	-	1	1	-	1	-	-	-	-	-	-	43	36	1	-	2	-	1	-	2
D-46	1	-	100	15	2	4	3	10	-	135	-	1	-	-	1	2	2	1	1	1	-	-	100	23	-	-	5	4	11	1	-
D-47	6	-	105	10	5	9	2	8	1	146	1	-	-	-	-	5	3	1	-	1	-	-	106	26	2	2	8	-	11	-	1
D-49	5	2	21	64	1	7	4	17	1	122	-	3	-	-	-	1	1	-	-	-	-	-	19	37	2	41	19	6	3	-	-
D-56[1/]	2	-	-	-	-	1	-	-	-	3	-	-	-	-	-	4	-	-	-	-	-	-	26	1	-	-	2	-	-	-	-
D-59	3	1	35	5	1	6	1	1	-	53	-	-	-	2	-	1	1	-	-	2	-	1	35	16	1	3	1	1	3	1	-
D-61[1/]	3	-	8	11	1	1	10	4	-	38	-	-	1	-	-	3	-	3	-	-	-	-	90	5	8	3	10	7	14	-	-
D-65[1/]	-	-	8	-	-	2	5	-	1	16	-	1	-	-	-	2	-	-	-	-	-	-	13	7	1	1	7	-	1	-	-
D-67[1/]	4	-	8	9	-	2	19	4	-	46	-	1	4	-	-	2	-	1	-	-	1	-	170	23	12	1	5	1	18	-	9

Table 6-1. (Continued)

Excavation Area	Debitage Lithic Technological Classes										Stone Tool Classes												Raw Material Classes								
	Bipolar Cores	Direct Percussion Cores	Undiagnostic	Bipolar	Primary Decortication	Secondary Decortication	Thinning	Shatter	Potlids	Debitage Total	Biface Fragment	Arrow Point Preforms	Arrow Points	Knife Preforms	Knives	Choppers	Chopper Fragments	Ovate Flake Tools	Utilized Flakes (Basalt)	Utilized Flakes (Chert)	Hammerstones	Pestles	Basalt	Chert	Quartzite	Silicified Wood	Chalcedony	Opal	Jasper	Obsidian/Ignimbrite	Granite
D-81 (N75/E20)	-	-	42	1	1	1	1	-	-	46	-	-	-	-	-	1	2	-	1	-	-	-	42	2	3	-	-	2	1	-	-
D-114 1/	13	1	25	33	-	-	20	11	1	104	3	-	2	-	1	3	-	-	-	-	-	-	357	-	13	15	29	2	4	-	3
D-128 1/	8	-	41	54	-	4	19	27	-	153	3	3	2	-	-	5	-	1	-	1	-	-	466	78	22	10	36	20	16	-	-
DOAH 4/	8	3	80	72	4	5	32	18	-	222	-	1	6	-	-	4	2	2	-	1	2	-	366	99	21	8	30	6	31	-	1
DAA	-	1	26	3	-	1	1	3	-	35	1	-	-	-	-	3	-	-	-	-	-	-	29	9	-	-	-	-	1	-	-
Open Area (Entire Sample) 5/	50	23	1494	515	22	166	159	311	31	2803	17	3	35	2	1	57	10	25	6	11	3	1	3123	844	125	326	164	34	139	3	33
Open Area (Lower Levels)	6	8	887	155	12	98	1	150	20	1337	4	1	7	2	1	20	4	2	4	6	2	-	921	170	22	286	7	3	10	-	7
Open Area (Upper Levels) 6/	44	15	588	360	10	67	158	156	11	1409	13	2	28	-	-	37	6	23	2	5	1	1	2184	671	101	40	156	31	127	3	26
S3/W65 (between D-46 - D-47)	-	-	14	3	1	-	4	1	-	23	-	-	-	-	-	1	-	1	1	1	-	-	17	8	-	-	-	-	2	-	-
S4/W65 (between D-46 - D-47)	-	-	5	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-

Table 6-1. (Continued)

Excavation Area	Debitage Lithic Technological Classes										Stone Tool Classes												Raw Material Classes								
	Bipolar Cores	Direct Percussion Cores	Undiagnostic	Bipolar	Primary Decortication	Secondary Decortication	Thinning	Shatter	Potlids	Debitage Total	Biface Fragment	Arrow Point Preforms	Arrow Points	Knife Preforms	Knives	Choppers	Chopper Fragments	Ovate Flake Tools	Utilized Flakes (Basalt)	Utilized Flakes (Chert)	Hammerstones	Pestles	Basalt	Chert	Quartzite	Silicified Wood	Chalcedony	Opal	Jasper	Obsidian/Ignimbrite	Granite
S5/W65 (between D-46 - D-47)	1	-	9	-	-	-	-	1	-	11	-	-	-	-	-	-	1	1	-	-	-	-	11	2	-	-	-	-	-	-	-
S13/W65 (between D-45 - D-46)	-	1	9	2	-	1	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	7	2	1	-	1	-	2	-	-
S18/W56 (between D-44 - D-48)	-	-	2	2	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	3	2	-	-	-	-	-	-	-
S7/W37 (between D-59 - D-49)	-	1	11	16	1	2	2	5	-	38	-	-	-	-	-	-	-	-	-	-	-	-	10	14	-	-	11	1	2	-	-
S1/W60 (near D-47)	-	-	3	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
S1/W62 (near D-47)	-	1	2	-	-	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-
S1/W63 (near D-47)	-	-	9	2	2	1	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	8	3	-	1	1	-	-	-	1
S150/W180	1	1	13	3	1	1	3	1	-	24	-	-	-	-	-	1	-	-	1	-	-	2	14	6	2	1	3	-	2	-	-
S125/W180	1	1	60	7	5	4	6	4	-	88	-	1	1	2	-	3	-	1	-	2	-	-	60	21	-	5	6	1	2	-	3

Table 6-1. (Continued)

Debitage Lithic Technological Classes

Excavation Area	Bipolar Cores	Direct Percussion Cores	Undiagnostic	Bipolar	Primary Decortication	Secondary Decortication	Thinning	Shatter	Potlids	Debitage Total
S100/W130	-	-	26	3	-	-	-	-	1	30
S58/W129	-	1	27	7	-	3	1	5	1	45
S25/W80	-	-	7	-	-	-	-	1	-	8
S00/E69	1	2	11	9	-	1	3	7	-	34
S74/E20	-	-	1	-	-	-	-	-	-	1
S124/E20	-	-	11	2	-	1	2	2	-	18
N100/E70	-	-	1	-	-	-	-	-	-	1
N125/E120	-	-	-	-	-	-	1	-	-	1
N00/W29	1	2	26	16	1	2	3	3	-	54
S325/W80 (below Flood Chute)	-	-	3	2	-	-	-	-	-	5
S425/W380 (below Flood Chute)	-	-	2	3	1	2	-	3	-	11

Stone Tool Classes

Excavation Area	Biface Fragment	Arrow Point Preforms	Arrow Points	Knife Preforms	Knives	Choppers	Chopper Fragments	Ovate Flake Tools	Utilized Flakes (Basalt)	Utilized Flakes (Chert)	Hammerstones	Pestles
S100/W130	-	-	-	-	-	-	-	-	-	1	-	-
S58/W129	-	-	1	-	-	-	-	2	1	-	-	-
S25/W80	-	-	-	1	-	-	1	-	-	1	-	-
S00/E69	-	-	-	-	-	-	1	-	-	1	-	-
S74/E20	-	-	-	-	-	-	-	-	1	-	-	-
S124/E20	-	-	-	-	-	-	-	-	-	-	-	-
N100/E70	-	-	-	-	-	-	-	-	-	-	-	-
N125/E120	-	-	-	-	-	-	-	-	-	-	-	-
N00/W29	-	-	-	-	-	-	-	-	-	1	-	-
S325/W80 (below Flood Chute)	-	-	-	-	-	1	-	-	1	-	-	-
S425/W380 (below Flood Chute)	-	-	-	-	-	-	-	-	-	-	-	-

Raw Material Classes

Excavation Area	Basalt	Chert	Quartzite	Silicified Wood	Chalcedony	Opal	Jasper	Obsidian/Ignimbrite	Granite
S100/W130	24	1	2	-	2	2	-	-	-
S58/W129	25	13	4	2	1	2	1	-	-
S25/W80	7	2	1	-	1	-	-	-	-
S00/E69	12	10	-	4	3	6	1	-	-
S74/E20	2	-	-	-	-	-	-	-	-
S124/E20	12	5	-	-	-	1	1	-	-
N100/E70	1	-	-	-	-	-	-	-	-
N125/E120	-	1	-	-	-	-	-	-	-
N00/W29	24	19	2	3	4	1	2	-	-
S325/W80 (below Flood Chute)	5	-	-	1	1	-	-	-	-
S425/W380 (below Flood Chute)	2	7	-	-	2	-	-	-	-

Table 6-1. (Continued)

Excavation Area	Debitage Lithic Technological Classes										Stone Tool Classes												Raw Material Classes								
	Bipolar Cores	Direct Percussion Cores	Undiagnostic	Bipolar	Primary Decortication	Secondary Decortication	Thinning	Shatter	Potlids	Debitage Total	Biface Fragment	Arrow Point Preforms	Arrow Points	Knife Preforms	Knives	Choppers	Chopper Fragments	Ovate Flake Tools	Utilized Flakes (Basalt)	Utilized Flakes (Chert)	Hammerstones	Pestles	Basalt	Chert	Quartzite	Silicified Wood	Chalcedony	Opal	Jasper	Obsidian/Ignimbrite	Granite
S275/W280 (below Flood Chute)	-	-	3	1	-	2	-	1	-	7	-	-	-	-	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-
S806/W380 (below Flood Chute)	-	-	2	-	-	-	-	1	1	4	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-

1. Collections from this unit, as with the others collected in 1978 and analyzed by J. J. Flenniken, exclude Basalt/Quartzite/Granite counts from the Debitage Lithic Technological Types.

2. Partially analyzed by Flenniken, Debitage excludes Basalt/Quartzite/Granite. A single 1 x 1 m^2 analyzed by Wilkinson includes all raw material types in Debitage Lithic Technological Type counts.

3. Includes net weight.

4. The upper levels (25-28) were analyzed by Flenniken and exclude Basalt/Quartzite/Granite from debitage counts, whereas level 29-33 include these raw materials in debitage counts. Levels 34-38 are below the housepit boundary and are therefore excluded from this count but are included in Lower Levels by Open Area count.

5. The totals for the Open Area (entire sample) do not equal the upper and lower level totals combined because some intermediate levels containing lithic material may have been excluded to eliminate zones in which mixing is a potential problem.

6. The totals of the Debitage Lithic Technological Types combine material examined by Flenniken (not including Basalt/Quartzite/Granite) and Wilkinson (includes all raw material types).

As a qualification on a single-function interpretation of the choppers as tools for breaking bones, however, it was noted that these specimens occur in considerable variety, the implication being that they could have diverse usages. Edge angles, edge damage, size, shape, and flake-removal patterns were recognized as highly variable. Some of this variety is illustrated in Figures 6-1, 6-2, 6-3, and 6-4. In contrast to the variety with respect to these attributes, raw material of these cobble tools is uniformly a fine-grained greenstone basalt. Cobble spalls or "spall knives" (Figure 6-2, b, c) and the anvil stones frequently associated with the greenstone choppers are, however, frequently on coarser basalts or other materials.

The finely flaked stone tools (e.g., scrapers and knives) made from fine grain materials (e.g., chert, silicified wood, opal, and obsidian) were notable for their relative scarcity (Flenniken 1977:92). A bipolar technique, particularly effective in the reduction of small-sized raw materials, was found to be strongly represented in the debitage from the site. Although systematic intrasite comparisons of lithic materials, debitage, and tool forms were not undertaken, the lithic technicians arrived at an impression that the collections from the site were relatively undifferentiated.

Lithic Assemblage Variability Between the Two Major Intervals of Site Occupation

In the light of the faunal assemblage patterns that were discussed in the previous chapter, it is of interest to consider what, if any, differences exist in the lithic assemblages from various areas of the site. Investigation of this question was unfortunately constrained by several factors. Quantitative data of the sort produced in 1978 and 1979 was not available from the 1976 and 1977 excavations and circumstances did not permit going back to tabulate such data. Excluding the OA-78 block excavation, the largest lithic samples from the site all came from the 1976 and 1977 season excavations of housepits 76, 96, 117, and 119. Lithic analyses for the materials collected in these areas during 1976 and 1977 focused primarily upon replication of stone tools with the result that there is minimal tabulated data for comparison to the collections recovered in 1978 and 1979. Because efforts to acquire funding for the completion of this work in a final analysis proved unsuccessful, analysis of lithic materials presented here relies heavily upon data generated from the last two seasons of work. Consequently, the artifact and debris counts that are available presently come largely from the right bank of the island (Table 6-1) and only from the OA-78 block excavation is there a sample large enough to hazard assemblage comparisons between the two major occupations. The overall picture is that cryptocrystalline lithic materials were scarce relative to faunal materials in this site and probably relatively scarce compared to most other housepit sites that have been reported in the region. Admitting all the constraints as well as the crude artifact categories that have been employed, the two major intervals of occupation at the site can be compared with the upper and lower levels

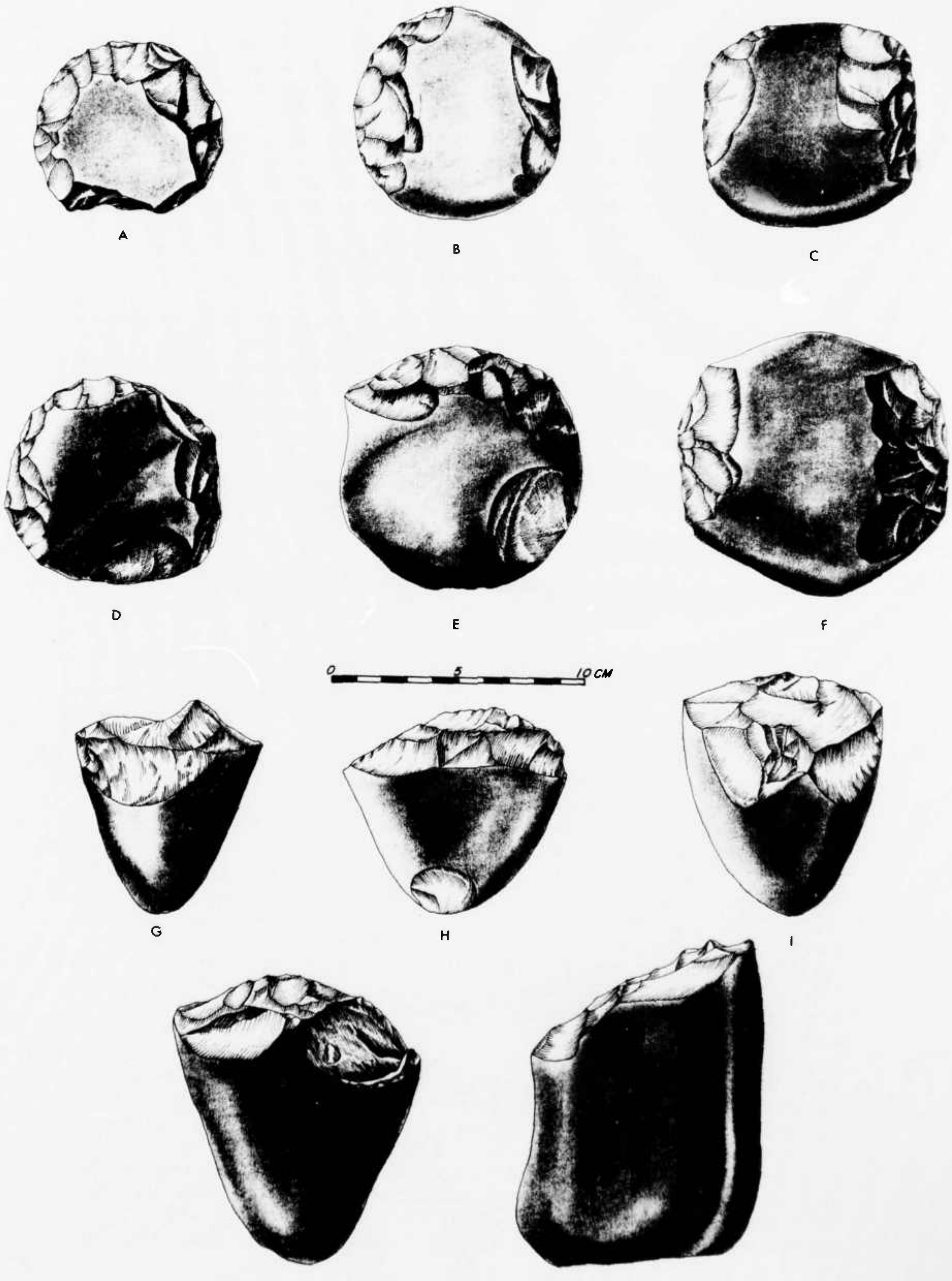

Figure 6-1. Cobble tools from the Strawberry Island site: A-F, two margins flaked; G-K, one margin flaked.

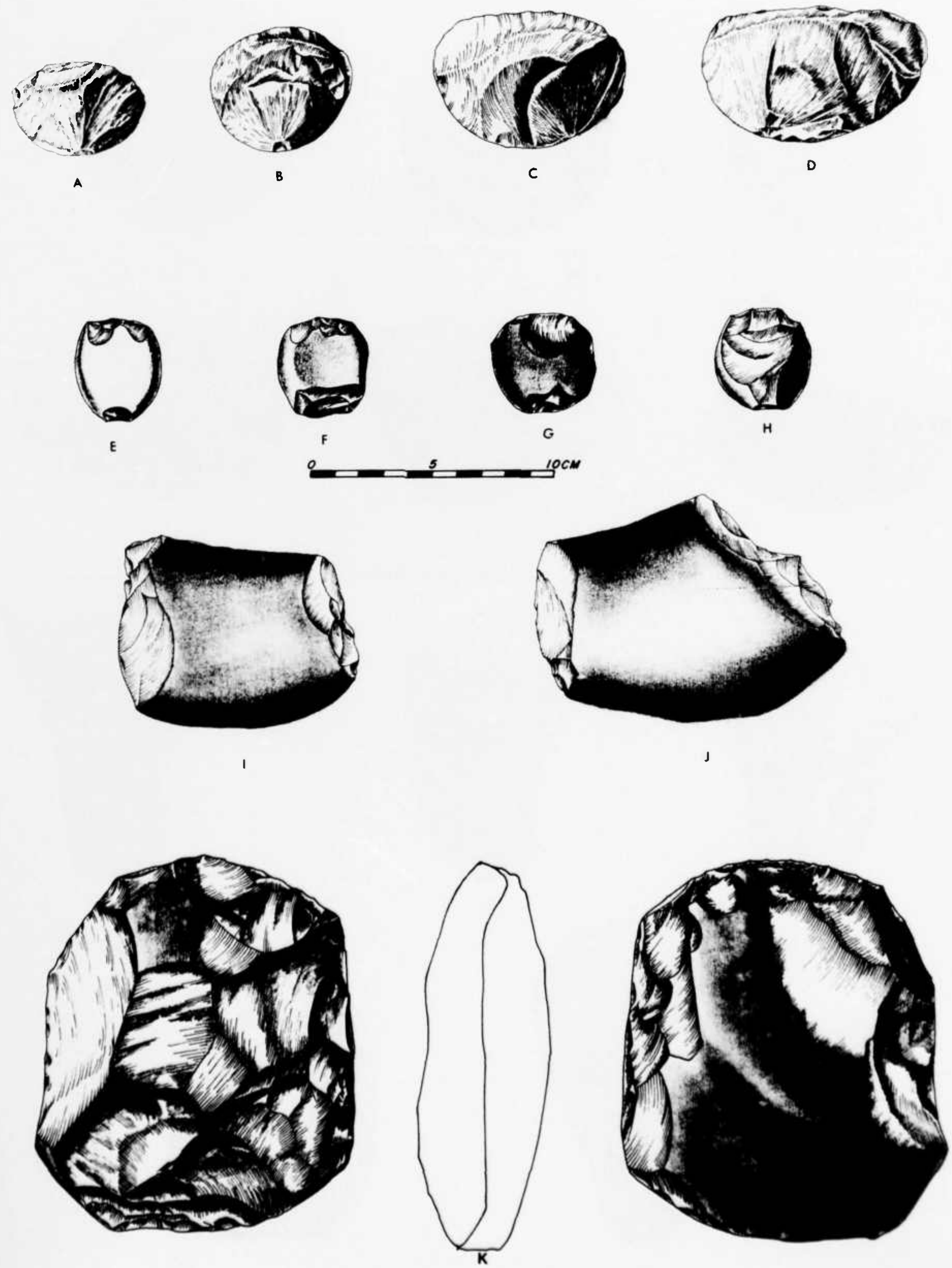

Figure 6-2. Cobble tools from the Strawberry Island site: A-D, "spall knives"; E-J, two margins flaked; K, bifacially flaked cobble.

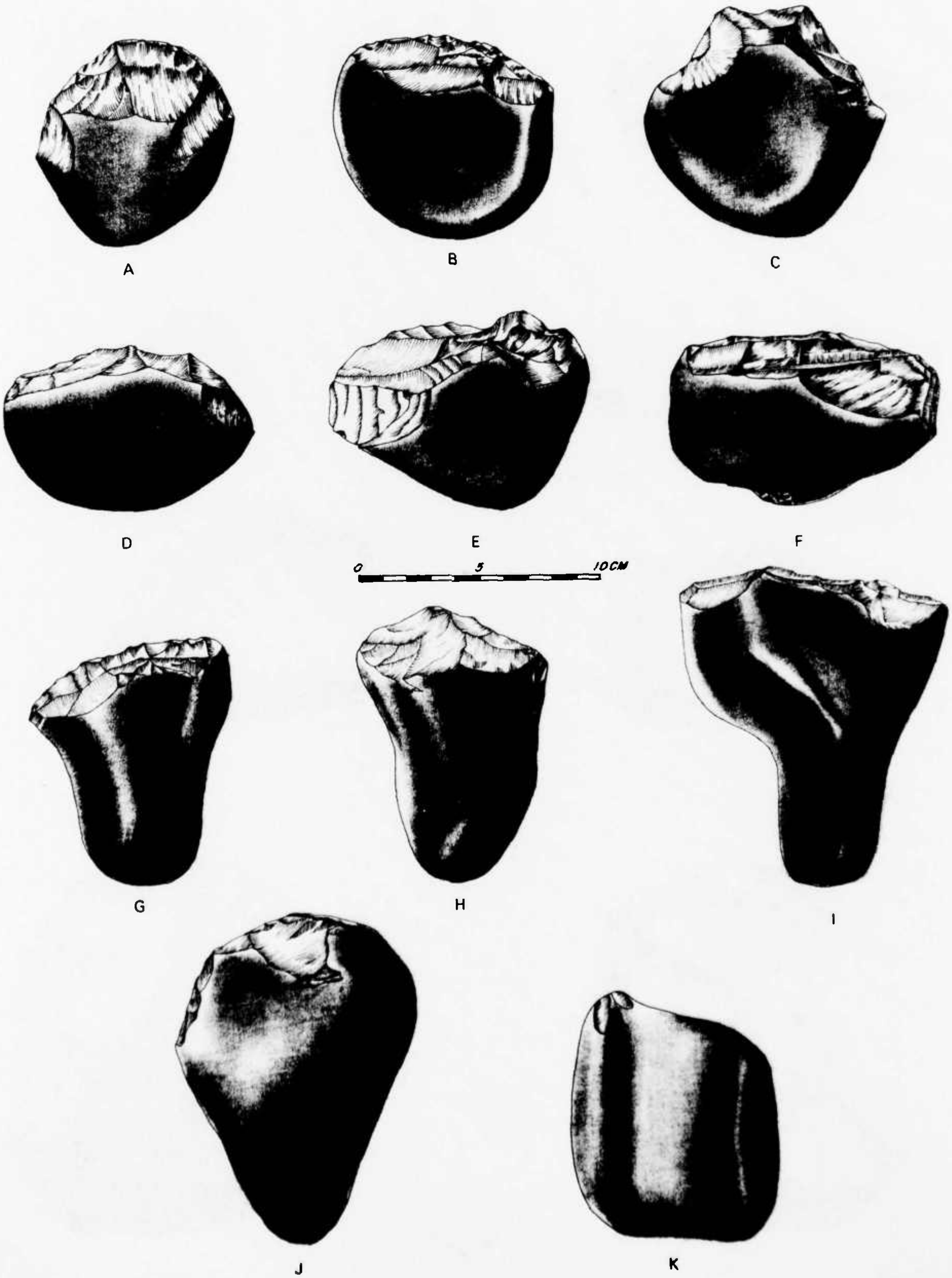

Figure 6-3. Cobble tools from the Strawberry Island site showing various patterns of flaking.

Figure 6-4. Elongate cobble tools from the Strawberry Island site exhibiting flaked and/or battered working edges.

of the OA-78 block excavations. Table 6-2 lists the percentages of the various artifact classes for the two principle stratigraphic divisions in the OA-78 unit. Even here the samples are rather small but certain differences in artifact frequencies seem noteworthy.

Relative frequencies of grossly categorized stone tools show an overall similarity in most tool classes. There are three tool classes which seem to be particularly different in terms of relative frequency between the upper and lower zones of OA-78. These include ovate flake tools, utilized flakes, and arrow points. Ovate flake tools represent only 3.8% of the tools in the lower zone while they rise to 19.5% in the upper zone. Utilized flakes, on the other hand, decrease from 18.8% in the lower zone to only 5.9% in the upper zone. Projectile points are nearly twice as abundant in the upper zone, constituting 24% of the artifacts from that zone compared to only 13.2% from the lower zone.

A similar comparison of upper and lower zones of OA-78 was made with respect to lithic debitage categories. Table 6-3 contains percentages of various kinds of debitage for the two zones. With this comparison, there are again three categories that show sizeable differences in frequencies for the two zones: thinning flakes, bipolar flakes, and undiagnostic flakes. Undiagnostic flakes are nearly three times as abundant in the lower zone of OA-78 than in the upper zone from the same area. Bipolar flakes jump dramatically from 11.6% to 36% between lower and upper zones. This is also reflected in a parallel increase in bipolar cores from 0.4% to 4.4% from lower to upper levels. Finally, thinning flakes jump from 0% to 22.3% between the lower and upper zones of OA-78. In general, there is strong indication in these figures that the lithic reduction process shifted towards a more economical (less wasteful) use of raw materials between lower and upper zones of OA-78. This shift was further substantiated through comparisons of debitage that was associated with salmonid-dominated faunal assemblages (D-46, D-47, D-61, and D-AA)) with debitage associated with pronghorn or rabbit-dominated faunal assemblages (D-30, D-45, D-59, and D-128). The two aggregate debitage collections produced from collapsing materials from these various areas showed basically the same contrasts in frequencies as did those from the two zones of OA-78.

One can enumerate a long list of factors which can be identified as limitations on the comparisons of these two lithic assemblages. At the top of this list would be the crude taxonomy employed and any number of inadequacies related to sampling. The fact remains, however, that the differences in percentage frequencies of certain commonly occurring tool forms and debitage types are substantial enough that they can not easily be dismissed as spurious. Furthermore, the major differences that do exist appear to be interrelated. Much of the variability in both tools and debitage appears to derive from differences in the availability of high quality cryptocrystalline material for making stone tools between the two intervals of occupation. Differences in availability here might relate either to a reduction in accessibility due to changes in annual home range or due to an actual exhaustion of local sources.

Table 6-2. Comparison of stone tool frequencies between upper and lower zones of the OA-78 block excavation.

Tool Categories	Lower Zone OA-78 (N = 53)	Upper Zone OA-78 (N = 118)
Biface fragment	7.5%	11.0%
Arrow point preform	1.9%	1.7%
Arrow point	13.2%	24.0%
Knife preforms	3.8%	0 %
Knives	1.9%	0 %
Choppers	38.0%	31.4%
Chopper fragment	7.5%	5.1%
Ovate flake tools	3.8%	19.5%
Utilized flakes	18.8%	5.9%
Hammerstones	3.8%	0.8%
Pestles	0 %	0.8%

Table 6-3. Comparison of lithic debitage classes from upper and lower zones of the OA-78 block excavation.

Debitage Class	Percentage Lower Zone (N = 1,337)	Percentage Upper Zone (N = 793)
Bipolar Cores	0.4	4.4
Direct Percussion Cores	0.6	0.6
Undiagnostic	66.3	20.8
Bipolar Flakes	11.6	36.0
Primary Decortication Flakes	0.9	0.5
Secondary Decortication Flakes	7.3	2.4
Thinning Flakes	0	22.3
Shatter	11.2	12.7
Potlids	1.5	0.1

Looking at the difference in debitage from the two assemblages, it is clear that higher frequencies of bipolar flakes, bipolar cores, and thinning flakes and lower frequencies of undiagnostic flakes can all be interpreted as evidence for more frugal lithic reduction in the later assemblage. There are fewer waste by-products of flint-knapping and heavier reliance upon a reduction technique suited especially well to small size raw materials in the upper zone of the OA-78 block excavation.

Looking at differences in stone tools between the two assemblages, further evidence for the same trend is apparent. Assuming that ovate flake tools or cobble spall knives, as they are sometimes called, represent cutting tools expediently manufactured from abundantly available basalt river cobbles, the higher frequency of these items in the later assemblages is suggestive of a trend toward greater economy in the use of valuable cryptocrystalline lithic materials. In effect, the spall tools appear to have substituted for flakes produced from direct percussion cores. This interpretation of spall tools as functional analogs for the utilized flake tools is strongly supported by the inverse relationship in frequencies of these two tool classes in the two assemblages. Raw material for manufacture of small crytocrystalline flake tools appears to have been of considerably greater value in the more recent assemblage. As will be discussed at greater length later, this contrast between the two assemblages probably reflects differences in the ranges and mobility of the site occupants during the two major intervals of site utilization.

The Cobble Tools

Tools made from cobbles represent upwards of 30% of all lithic tools in the collections from Strawberry Island. The majority of these cobble based tools are what have commonly been referred to as cobble choppers. The lithic assemblage from Strawberry Island seems to have unusually high frequencies of these tools when compared to other housepit sites reported along the Lower Snake such as Three Springs Bar (Daugherty et al. 1967:Table 13) and Bone-in-the-Throat (Schalk 1983:167).

Some of the variability in cobble choppers can be appreciated in Figures 6-1, 6-2, 6-3, and 6-4. As mentioned earlier, the size ranges are great as is variability in the nature of working edges and degree of wear present on the working edges. Continuing analyses of these tools will, in all probability, demonstrate that there are at least two or more distinctive functional forms represented among those artifacts referred to as cobble choppers.

It at first seems paradoxical that these tools should occur in such high frequencies in the Strawberry Island lithic assemblages if their use relates primarily to bone breakage. That is, one would expect choppers to occur in higher frequencies in more game rich areas of the Plateau if their function related primarily to bone marrow and grease production. There are at least three possibilities that may account for

the high frequency of these tools in assemblages from what is probably the least productive region for ungulates in the entire Plateau.

The first is that the scarcity of game resources in aboriginal economies of this region would have favored more intensive processing of these resources. Binford (1978), for example, suggests that the intensity of processing of bone for marrow and grease probably varies inversely with the importance of large game in the diet among hunter-gatherers generally.

The occurrence of high frequencies of these tools along the Columbia in locations thought to be fishing stations might be viewed as favoring the interpretation of these tools as having a fishing related function (Thoms et al. 1983).

The third possibility is that the cobble choppers functioned at least partially in other ways unrelated to breakage of bone. Processing of plant fiber, perhaps for clothing, would be an alternative function worth considering for some of the specimens. Future investigation of how these items covary with faunal remains and other lithic tools will probably permit clarification of this question.

Nelson (1973:386) suggests that cobble tool frequencies tend to be much higher in the southern portion of the Columbia Plateau than in the northern portion for the past 4,000 years. He further suggests that differences in the frequencies of cobble tools between the two areas may be indicative of a prehistoric linguistic boundary between Salishan and Sahaptian. As an alternative to this ethnic or cultural explanation for assemblage variability, it is postulated here that cobble tool frequencies may vary inversely with the carrying capacity for ungulates across the various regions of the Plateau. The high frequencies of cobble choppers in the Strawberry Island lithic assemblages might, therefore, be interpreted as a reflection of the scarcity of mammal resources. Another functional argument would be that the frequencies of these items in residential sites will vary in direct proportion to the importance of fishing in subsistence. It will be informative to compare relative frequencies of these items from assemblages deriving from functionally analogous sites (e.g., winter villages) situated along precipitation clines or other environmental gradients of the Plateau.

Projectile Points

The lithic technicians who analyzed the collections from Strawberry Island did not feel that projectile point variability from the site warranted morphological distinctions:

> Measuring arrow point length, width, thickness, depth of notch, length of stem, curvature of base, etc., for the purpose of defining morphological types is relatively worthless as the end product of lithic analysis. These statistics are, in reality, only measuring two situations: (1) the skill of the knapper, and (2) the restrictions that the stone places upon the knapper (Flenniken 1977:88).

Viewed only from the perspective of how projectile points or other formal tools were made, this may be a defensible position albeit one which places the limitations of replication in bold relief. For archaeologists attempting to understand how specific artifact forms might have functioned in a cultural system or attempting to explain recurrent distributional patterning of particular forms in space and time, the technical details of tool manufacture may be largely irrelevant if not trivial. In this light, at least superficial attention is devoted here to formal variations in the projectile points.

Recognizing that faunal assemblages and architectural forms at Strawberry Island exhibited substantial intrasite variations, it is of particular interest here to consider how projectile point forms correlate with those differences. Following traditional procedures, the projectile points were categorized using haft element morphology as the basis for categorization.

There are 86 point specimens from the site that are complete enough to classify and for which locational data is available. Unfortunately, this sample is small and many excavation units produced few if any points. Intrasite comparisons of points along the lines of the faunal analysis in the previous chapter is not possible. For the same reasons, comparisons of the upper and lower zones of the largest block excavation (OA-78) are hindered by an inadequate sample; few points were recovered from the lower zone. The discussion here, then, focuses on description of the entire collection of points from the site; a few notable intrasite differences that were detected are discussed thereafter. Metric data including length, width, thickness, shoulder width, base length, base width, neck width, notch width, blade length, and weight are presented in Appendix E.

A basic distinction was made between points with neck widths greater than or less than 8mm. This distinction presumes to segregate arrow points from atlatl darts (Dick 1965; Aikens 1970; Corliss 1972; Thoms 1977; Thomas 1978). Within these two divisions, further subdivisions were based upon notch form (side-notched corner-notched, and base-notched) and stem shape (rectangular, expanding, and contracting). There are, then eight point classes that are represented by at least one specimen:

<u>Dart Size</u>

side-notched (1 specimen; Figure 6-5a)
corner-notched/expanding stem (1 specimen; Figure 6-5b)
corner-notched/rectangular stemmed (1 specimen; Figure 6-5c)

<u>Arrow Size</u>

corner-notched/expanding stem (32 specimens; Figure 6-5d-1)
corner-notched/rectangular stem (41 specimens; Figure 6-6a-i)
corner-notched/contracting stem (1 specimen; Figure 6-61)
side-notched (5 specimens; Figure 6-6m-o)
base-notched (4 specimens; Figure 6-6j-k)

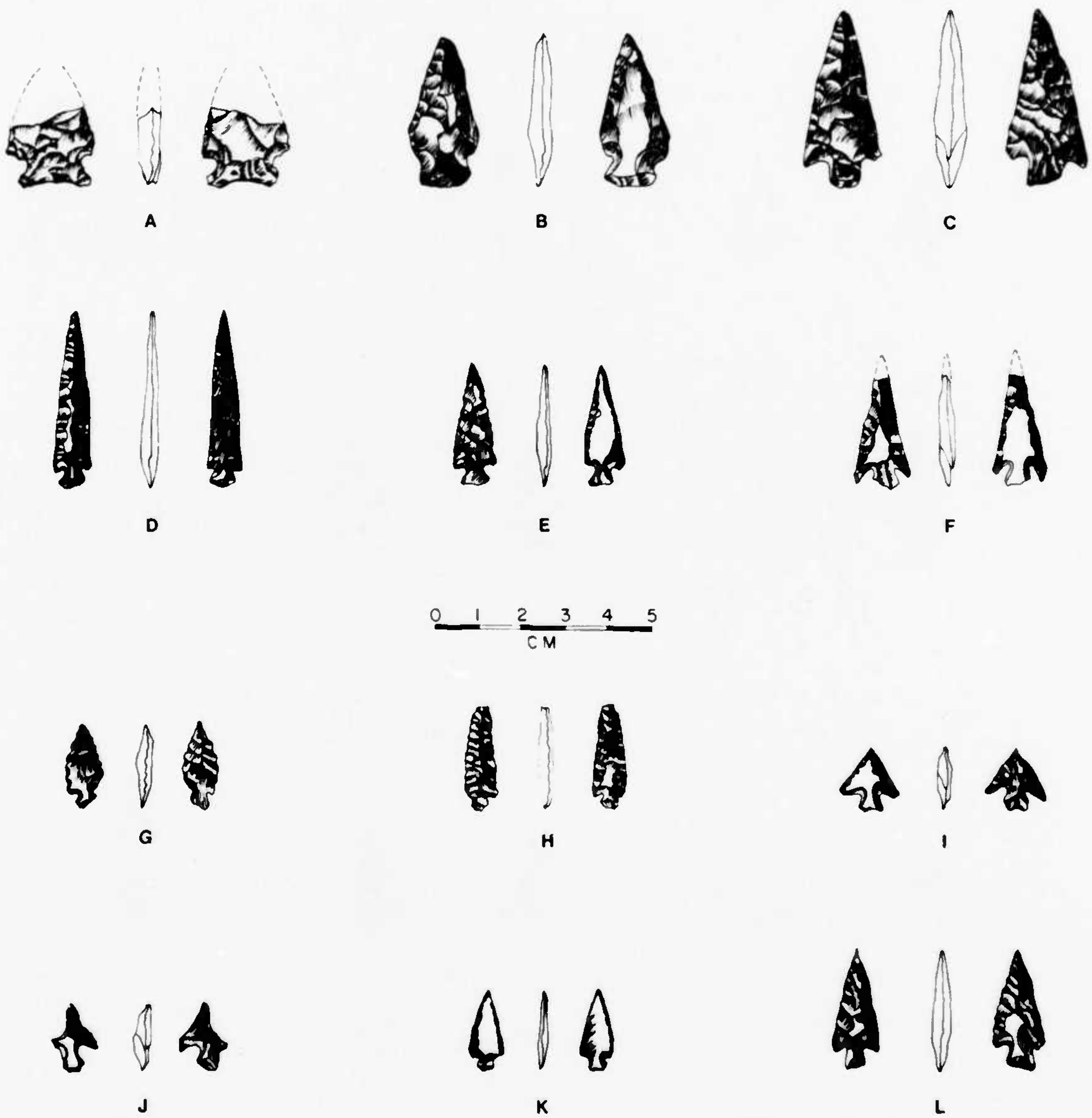

Figure 6-5. Projectile points from the Strawberry Island site; dart and arrow size: A, side-notched; B, corner-notched/expanding; C, corner-notched/rectangular; D-L, arrow-size points, corner-notched/expanding stem.

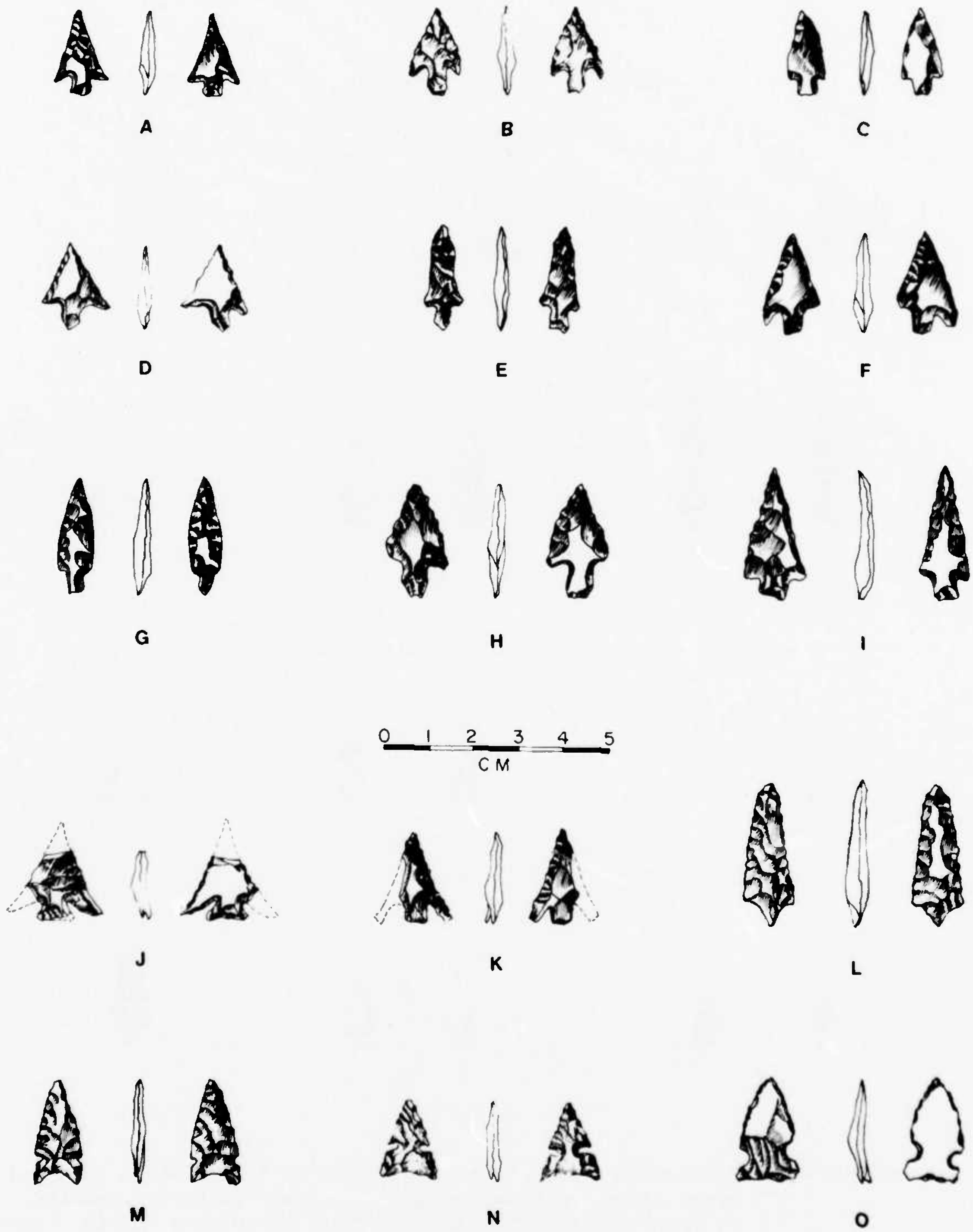

Figure 6-6. Projectile points from the Strawberry Island site, arrow size: A-I, corner-notched/rectangular stem; J-K, base-notched; L, corner-notched/contracting stem; M-O, side-notched.

The corner-notched/rectangular stemmed forms ("Wallula Rectangular-stemmed"[Nelson 1969:95]) represent 48 percent of all points in the sample; the corner-notched/expanding stem forms amount to 37 percent of the sample. Distinguishing the two forms is sometimes a matter of qualitative judgment inasmuch as the two forms seem to grade into one another.

All other point forms represented in the collection occur in low frequencies together amounting to only 15 percent of the total point sample from the site. There are three specimens that have neck widths in the dart point range. All three were recovered in the right bank housepit cluster--a large side-notched point from D-61 (Figure 6-5a), a corner-notched/expanding stem point from D-76 (Figure 6-5b), and a large corner notched/rectangular stemmed point from the upper levels of OA-78 (Figure 6-5c).

There are four specimens that are base-notched with expanding or rectangular stems (Figure 6-6j-k). These points were recovered from D-9, D-30, D-96, and D-117.

The only corner-notched/contracting stem specimen was recovered from the upper zone of OA-78 (Figure 6-6l).

Finally, there are five small side-notched points in the sample (Figure 6-6m-o) and these were all found in D-117 of the left bank housepit cluster.

Sample size is obviously a constraint upon making definitive statements regarding relative frequencies of various point forms and this is especially problematic with respect to the earlier occupations of the site which contributed a relatively small portion of the total collection. Nonetheless, there are a few contrasts in the frequencies in projectile point forms that are tentatively identified as correlates of the two major occupation intervals indicated by faunal assemblages and architectural forms.

There is at least weak indication that the corner-notched expanding stem point varieties occur in higher frequencies in the earlier steep-walled housepits characterized by salmonid dominated faunal assemblages. The corner-notched/rectangular stemmed or "Wallula Rectangular stemmed" point variety appears to be more common in those areas of the site which post-date the use of the steep-walled houses (D-96, D-117, D-119, D-128, and the upper levels of OA-78). With larger samples and better chronological control, it is possible that there would be a demonstrable trend toward increased frequencies of rectangular stemmed points through time. Other possible differences in point forms between assemblages of different ages are only hinted at by those specimens that were encountered in very low frequencies. Only three specimens with neck widths in the range of dart points were found and all were from the right bank housepit cluster. Four small side-notched points of a variety usually assumed to date to the last two or three centuries of the prehistoric era were all encountered in a single housepit (D-117) in the left bank housepit cluster. These occurrences

conform in a general way with our notions about the age of these point types and differences in age between the two housepit clusters.

Stone Tools that are Notably Absent or Rare

Contrary to the popularized view of Plateau prehistory as a snowballing sequence in which new items are continuously added and few items are deleted, many lithic items commonly found in archaeological sites in other areas of the Plateau or in sites from different time periods are conspicuously missing from Strawberry Island. To list only a few, there are no hopper mortars, no stone adzes, no perforated net weights, no edge ground cobbles, no thumb-nail end scrapers, no stone beads, and no incised stones or decorative objects. This kind of list could be expanded indefinitely but this should be sufficient to illustrate the point.

In the total site collection, there are only five notched discoidal cobbles or "net weights" and a single "banded sinker" (Cleveland et al. 1977:Figure 22). Aside from these few items, there is little in the stone tool technology at this site that would ordinarily be linked to fishing related activities.

Artifacts confidently identifiable as related to plant processing are notably absent or scarce. Exceptions here include a mortar fragment and two pestle fragments. While large, flat cobbles with pecked surfaces are commonly encountered furniture in the housepits at this site, these are generally presumed to have functioned primarily as anvil stones for the processing of animal bone. Worn surfaces on these "anvil stones" do not exhibit the well-defined, circular patterns expectable from usage as hopper mortar bases. Unless, as was suggested previously some of the heavily blunted cobble choppers functioned in some technique for processing plant foods, the absence of obvious plant related tools is an important characteristic of the collections from the site. It may be that the aridity of this portion of the Columbia Plateau placed severe limitations on the role of plants in subsistence but this is clearly a matter worthy of more attention in future research.

Tools commonly assumed to have functioned as hide-working tools are also conspicuously absent or scarce. Based upon stone tool assemblages from other housepits that have been excavated on the Lower Snake, one would expect substantial numbers of thumb nail end-scrapers. This expectation is not fulfilled. Similarly, perforating tools of stone or bone seemed noticeably scarce. The lack of hide-working tools is actually consistent with the fact that carrying capacity of ungulates would have been quite limited in the region during climatic intervals comparable to those of this region today. During drier periods, animal resources would have been further depressed. Reflecting the generally poor quality of large herbivore habitat in such an arid setting, pronghorn overwhelmingly dominate the ungulates represented in the faunal assemblages. This in no way should be interpreted as evidence for their quantitative importance in subsistence during the time period

under investigation. Moreover, pronghorn are well known for having poor or even useless hides (Einarsen 1948:30; Wormer 1969:1288). This area of the Plateau may have provided rather unique problems with respect to clothing and it is quite possible that plant fiber or rabbit fur clothing may have been of importance to the prehistoric inhabitants of the region. Ethnohistoric sources seem to agree on the "impoverished" character of the clothing worn by the Indians in the more arid regions of the Basin in historic times (Smith 1982:61). The archaeological evidence seems to support the view that this situation was of long-standing in the area.

Summary

Several general characteristics of the lithic assemblages from this site have been identified. Some of these can be derived from immediate table-top impressions but others require more thorough examination and intrasite comparisons of relative frequencies of various tool and debitage classes. To the table-top observer, the assemblage is unusual in having an abundance of cobble tools (especially cobble choppers), relatively few smallflaked stone tools or debitage, and few distinctive flaked stone tool forms. By the standards of archaeologists and collectors alike, the projectile points would be recognized as uninspiring in terms of the quality of workmanship exhibited; they would also be recognized as generally lacking in diversity as well. To the keen observer, the absence or scarcity of a number of tool forms would be apparent and these would include scrapers, tools obviously related to plant processing, wood working, and even fishing. Many observers would probably find it difficult to accept that the lithic assemblage came from a residential site that is thought to have been occupied for at least several months out of an annual cycle.

Closer examinations of the kinds of patterning that are only comprehensible in tabular form would probably not lend many additional insights unless one were to compare this site assemblage to others in terms of relative frequencies of stone tools and debitage. It is only with the assistance of information obtained from <u>other</u> components of the archaeological record--the faunal remains, stratigraphy, and structural remains--that certain intrasite differences in the lithic assemblages can be distinguished.

Intrasite comparisons of relative frequencies of stone tool forms were inhibited by their relatively low densities throughout much of the site, by the small size of many excavation units, and by the lack of opportunity to analyze collections from previous seasons and important areas of the site in order that they might be rendered compatible with data from the 1978 and 1979 seasons. Nevertheless, comparisons of assemblages representing the two major intervals of occupation that have been identified in the site were made for a block excavation (OA-78) in the right bank of the island. This comparison indicated that there are substantial differences between these two assemblages in the relative frequencies of three commonly occurring tool classes: ovate flakes, utilized flakes, and projectile points. Ovate

flakes and projectile points are much more common and utilized flakes are less so in the later assemblage when compared to the earlier assemblage.

Comparisons of the debitage from the upper and lower zones of the same area indicated that there are also sizable differences in the relative frequencies of certain debitage classes between these two zones. Bipolar flakes, bipolar cores, and thinning flakes were found to be considerably more abundant in the upper zone than in the lower zone. Undiagnostic flakes, on the other hand, occur in lower frequencies in the upper zone when compared to the lower zone. This patterned variation which was attributed to two major intervals of site occupation was further substantiated by comparisons of the collapsed lithic assemblages from several smaller excavation units which yielded salmonid dominated faunal assemblages with several collapsed lithic assemblages from various excavation units that yielded either pronghorn or rabbit dominated faunal assamblages. The conclusion from these comparisons of debitage class frequencies was that all of these differences seem to derive largely from differences in economizing behavior with respect to lithic raw materials. In particular, occupants of the site during the later interval of site use made more exhaustive use of cryptocrystalline materials for tool manufacture. Smaller quantities of material were wasted in the form of undiagnostic flakes and a bipolar technique was employed that permits more effective use of small pieces of raw material.

This explanation for differences in debitage can, in turn, be linked to the differences in tool frequencies evident between the two occupation intervals. It is argued that higher frequencies of cobble spall tools and lower frequencies of utilized flakes in the later tool assemblage from OA-78 reflects the substitution of a tool form that can be manufactured expediently from readily available basalt cobbles for increasingly valued cryptocrystalline cutting tools. Further substantiation of the argument for the value of cryptocrystalline raw material is the fact that a large percentage of the projectile points from the site were manufactured directly on flakes rather than from preforms.

Examination of the projectile points indicated that two corner-notched varieties, one with rectangular stems and the other with expanding stems, constituted 85 percent of the total point sample from the site. The other 15 percent of the sample was made up of six other forms all occurring in low frequencies. In terms of intrasite distributions there is some indication that the corner-notched points with expanding stems were more frequent in the earlier interval of site occupation and the corner-notched with rectangular stem points occur in higher frequencies in the later occupation. Adding at least weak support to the general picture of site occupational history was the occurrence of three dart-size points in the right bank housepit cluster and four small side-notched points in one housepit of the left bank housepit cluster.

Given the analytical procedures that have commonly been employed in Plateau archaeology which rely heavily upon presence/absence criteria centered upon a few temporally diagnostic stone tools, this site would most likely have been described as one that was internally undifferentiated and representative of a period of time during which there was no cultural change. The kinds of intrasite differences in lithics that have been identified here have probably gone unattended in previous archaeological studies in the region because they are largely expressed in terms of <u>frequency shifts</u> rather than accretion and deletion. Another implication of the material presented in this chapter is that much of the lithic tool inventory and probably the resultant debitage as well might be attributed to hunting-related activities and the processing of mammalian food resources. Accepting the accuracy of such an assumption, we are faced with the peculiar situation of a lithic assemblage that pertains primarily to the exploitation and processing of game resources in an environment that has probably been unusually limited in its ability to support such resources except during intervals considerably wetter than today. It now appears that climate during a portion of the interval during which the site was occupied was probably <u>more arid</u> than today's climate. It would follow from this line of reasoning that the lithic assemblages might be largely referrable functionally to a relatively minor component of a total subsistence system. If so, one might reasonably wonder how much credence can be given general ideas about long term culture change that have been derived largely from stone tools.

REFERENCES CITED

Aikens, C. Melvin
1970 Hogup Cave. University of Utah Anthropological Papers 93.

Binford, Lewis R.
1978 Nunamiut Ethnoarchaeology. Academic Press. New York.

Cleveland, G. C., J. J. Flenniken, D. R. Huelsbeck, R. Mierendorf, S. Samuels, and F. Hassan
1977 Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976: A Late Prehistoric Village Near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 46.

Corliss, David W.
1972 Neckwidth of Projectile Points: An Index of Cultural continuity and change. Occasional papers of the Idaho State University Museum 29.

Daugherty, Richard D., Barbara A. Purdy, and Roald Fryxell
1967 The Descriptive Archaeology and Geochronology of the Three Springs Bar Archaeological Site, Washington. Laboratory of Anthropology, Washington State University, Report of Investigations Number 40.

Dick, Herbert
1965 Bat Cave. School of American Research Monograph 27.

Einarsen, A. S.
1948 The Pronghorn Antelope and Its Management. The Wildlife Management Institute. Washington, D. C.

Flenniken, J. Jeffrey
1977 Analysis of the Lithic Tools, 1976 Sample. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976, A Late Prehistoric Village near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 46.

1978 Further Technological Analyses of the Lithic Artifacts from the Miller Site, 45FR5. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), a Late Prehistoric Village Near Burbank, Washington, edited by Gregory C. Cleveland. Washington Archaeological Research Center, Washington State University, Project Report Number 72.

Nelson, Charles M.
1969 The Sunset Creek Site (45KT28) and Its Place in Plateau Prehistory. Laboratory of Anthropology, Washington State University, Reports of Investigations Number 47.

1973 Prehistoric Culture Change in the Intermontane Plateau of Western North American. In The Explanation of Culture Change: Models in Prehistory, edited by Colin Renfrew. University of Pittsburgh Press, Pittsburgh.

Schalk, Randall F. (editor)
1983 Archaeological Testing of the Prehistoric Site at Lyons Ferry. In Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, Near Lyons Ferry, Washington, Laboratory of Archaeology and History, Washington State University, Project Report Number 8.

Smith, Allan H.
1982 Ethnohistory and Ethnography of the Priest Rapids Reservoir. In An Archaeological Survey of the Priest Rapids Reservoir: 1981, edited by Randall F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Reports Number 12.

Thomas, David H.
1978 Arrowheads and Atlatl Darts: How the Stones Got the Shaft. American Antiquity 43:461-472.

Thoms, Alston
1977 A Preliminary Projectile Point Typology for the Southern Portion of the Northern Rio Grande Region, New Mexico. Unpublished Master's thesis, Department of Anthropology, Texas Tech University, Lubbock.

Thoms, Alston V., Sheila J. Bobalik, Karen Dohn, Todd R. Metzger, Deborah Olson, and Stephan R. Samuels
1983 Archaeological Investigations in Upper McNary Reservoir: 1981-1982. Laboratory of Archaeology and History, Washington State University, Project Report Number 15.

Wilkinson, Robert
n.d. Lithic Analysis of the 1979 Collection from 45FR5. Ms. on file, Laboratory of Archaeology and History, Washington State University, Pullman.

Wormer, Joe Van
1969 The World of the pronghorn. J.B. Lippincott Company, Philadelphia and New York.

CHAPTER 7

GENERAL SUMMARY AND IMPLICATIONS

by

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Excavation strategies and analytical procedures associated with the 1978 and 1979 seasons of work at Strawberry Island were directed at documenting intrasite variability. This effort was guided by the surface distributions of housepit features as they are known from site maps and aerial photographs. In turn, the excavations were intended to yield information on the archaeological significance of poorly understood spatial structuring in surface features. The results of this general objective of the project are the principal focus of this summary.

Various lines of evidence indicate that the differences observed in the form and spacing of surface depressions are indeed associated with differences in faunal and lithic assemblages as well as house forms. The earlier housepits constructed on the site all appear to be of the steep-walled form. These early houses were distributed widely along the right bank of the island. Though detailed stratigraphic analyses of several areas excavated on this side of the site were not presented, all available evidence suggests that most, if not all, of the surficially visible housepits here were originally built and occupied during a relatively brief interval of time. It appears that only one of the radiocarbon dates from the site derives from this early occupation, and it gave an age estimate of 1,395±80 B.P. Assuming relative contemporaneity of most of the other housepits of this occupation, the entire occupation is at least seven and perhaps eight centuries earlier than any of the dated house floors associated with the later interval of occupation of the site.

The assumption that all of the steep-walled housepits of the right bank housepit cluster were occupied at nearly, if not precisely, the same time is partially supported by stratigraphic evidence. From sediment deposition in the OA-78 block excavation, it was determined that the two depositional zones containing quantities of cultural material were vertically separated by 20-40 cm of sediments that were sterile or characterized by relatively low artifact and debris densities. This same hiatus in the deposition of cultural materials was also encountered in a number of the 1 m^2 test units in the right bank housepit cluster. Given the degree of post-depositional vertical movement of cultural items expectable in sandy sediments (Gifford and Behrensmeyer 1977; Wood and Johnson 1978), it is likely that this vertical segregation actually masks to some degree the evidence for naturally deposited sediments being laid down between the two occupation

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zones. From our understanding of depositional rates and the process by which the island was formed (Mierendorf, Chapter 4), the vertical separation between culture-bearing zones of the right bank housepit cluster seems to broadly conform with what would be expected from an occupational hiatus of several centuries.

It is, of course, possible that when additional radiocarbon dates are assayed from the floors of these steep-walled housepits the apparent six to eight century hiatus will disappear. On the other hand, some of the steep-walled structures included in the earlier occupation zone might have been constructed and occupied earlier than indicated by the single date from the bottom floor of the D-9 trench. Neither of these possibilities seems to be as consistent with the facts as they are known to us as the interpretation that the steep-walled houses were contemporaneously occupied. The picture is further complicated by the fact that some of the housepits constructed during this early interval, especially those nearest the riverbank, had multiple occupation floors.

The earlier, steep-walled housepits tend to have substantially lower densities of artifacts and debris than are associated with the floors of the later, saucer-floored housepits. Where faunal assemblages clearly deriving from the early occupation can be separated out, they tend to be strongly dominated by salmonid remains in terms of relative frequencies of identified elements. Rabbit and pronghorn remains are strictly secondary in these assemblages though when the saucer-shaped floors are superimposed in the steep-walled housepits, faunal signatures are not dominated by salmonids or are less strongly so. Lithic assemblages from the occupation zone associated with the steep-walled housepits tend to have relatively high frequencies of utilized flakes, relatively low frequencies of projectile points, and low frequencies of cobble spall knives. Debitage frequencies indicate only limited use of a bipolar reduction technique and high frequencies of undiagnostic flakes in this zone.

The subsequent occupations of the site were very different in character. These later occupations frequently involved placement of saucer-floored structures in the depressions present from the earlier interval of occupation. Several radiocarbon dates from the saucer-floored housepits and the absence of items of Euro-American manufacture suggest that this interval of occupation spanned from about 600 to 200 B.P. Occupations of this later interval are distinguishable by faunal assemblages that are dominated by rabbit and/or pronghorn. They are also distinctive from the earlier cultural layer in terms of house form and the character of the house floors. These houses were generally larger than the earlier ones and saucer-shaped in their cross-sections. The dark occupation layers in these structures tend to be thick, relatively rich in artifacts and debris, and are frequently superimposed on top of one another with little evidence for cleaning prior to re-occupation. Compared to the steep-walled structures, well defined hearths or charcoal-stained areas are much more commonly encountered in the saucer-floored houses. These hearths seem to be more centrally placed within the saucer-floored structures than in the steep-walled forms although excavations of the latter were too limited to make a

conclusive statement in this regard. The lithic assemblages associated with this later interval of occupation are characterized by relatively high frequencies of spall knives and projectile points and relatively low frequencies of utilized flakes. Debitage frequencies reflect much greater reliance upon bipolar reduction and apparently a greater concern with economical use of cryptocrystalline raw materials.

In general, then, the two distinctive architectural forms have been found to exhibit rather consistent differences in their associated faunal assemblages, lithic assemblages, the quantities of debris on living floors, and possibly hearth features.

Synopsis of Site Occupation History

In proposing a model of occupation history for the site, it must be emphasized that substantial areas were explored only minimally, if at all. At the same time, enough pattern redundancy was encountered in rather widely separated areas to permit formulation of a tentative model that is probably accurate in its broad outline.

Initial housepit construction on the site occurred along the right bank of the island facing onto the minor channel of the river. These structures, perhaps a hundred or more extending from near the upper end of the island down to the first flood chute, were constructed with steeply sloping (70° to vertical) walls and flat floors excavated 50-70 cm, below ground surface. A single radiocarbon date from one of these houses suggests this interval of construction occurred around 1,400 B.P. Stratigraphic evidence from several areas of the right bank cluster indicates that most of these structures were constructed within a very brief interval of time in depositional terms. Noncontemporaneity of occupation is generally much easier to demonstrate than contemporaneity; evidence for noncontemporaneity of the initial housepits was, nonetheless, not identified. Lacking any reasonable explanation for why so many housepits would have been excavated in such a confined area of the landscape in such a relatively brief interval of time, one is led to the provisional conclusion of a contemporaneous occupation by a group of people possibly numbering in the hundreds. Beyond noting that artifact and debris densities seem very low on the floors of these houses, we are without a solid methodological foothold for estimating how many seasons of use are represented in these structures. It seems likely that many of these housepits were not reoccupied over any significant time span (more than a few decades) because there is no evidence for multiple floors, minimal evidence for a midden ring in the depression rims, and no floor remnants suggestive of re-excavation. A few (e.g., D-46), however, do exhibit such characteristics and certain housepits close to the river in the right bank housepit cluster contained as many as four or five floor remnants. This fact would seem to imply that smaller groups subsequently occupied a few of the very large number of housepits that were built during an earlier major interval of construction and housepit occupation.

It is unclear yet whether an occupational hiatus occurring across much of the right bank housepit cluster is also represented in these housepits containing multiple floors but it does appear that the site was partially or completely abandoned for an interval of several centuries. The second major interval of occupation, in any case, occurred after a considerable amount of natural deposition had occurred across the island. A new architectural form heralds this second major occupation interval and a series of radiocarbon dates suggests that this interval may have begun around 600 B.P. and extended up to the approximate time of major impacts of the horse and disease contagions. These structures were characterized by gently concave floors and the absence of well-defined walls. After standing vacant for several centuries, some of the right bank housepits were reoccupied during this later occupation. It appears that there was a preference for larger depressions and those closer to the river in this second occupation interval. Horizontal extent of the site increased and houses were constructed apparently for the first time on the left bank of the island. Assuming that objects of Euro-American manufacture began arriving in this region during the mid-1700s, the site was finally abandoned immediately prior to that time.

Site Structure and Spatial Organization

Variations between the two major housepit clusters in the size and spatial organization of surfically visible housepit depressions were discussed in Chapter 2. The strategies employed in testing the site in 1978 and 1979 were geared to investigate such patterns within the limits of small scale excavation units. It is appropriate in this section to examine surficial spatial structure in the light of the subsurface evidence now available.

It was observed from the site map and also from aerial photographs that the left bank housepits on the site tended to be larger on the average than those of the right bank. It now appears that this difference is related to the distribution of two architectural forms across the site. The saucer-floored housepits tend to be larger on the average than the steep-walled ones. It appears that the latter house form is largely restricted to the right bank housepit cluster and this is associated with the occurrence there of numerous small depressions. It will be recalled from histograms of depression areas in Chapter 2 (Figure 2-3) that depressions with areas under 30 m^2 were almost exclusively confined to the right bank housepit cluster. It now appears that the housepits on the left bank of the island are mostly (perhaps exclusively) the saucer-floored varieties--at least no exceptions were encountered in those that have been investigated. Given the horizontal stratification of the two house forms, then, the depression size differences between the two major housepit clusters correspond well with the proposed occupational history of the site.

But what about the right bank housepit cluster? If both components are vertically stratified there, is there detectable surface

evidence for the occurrence there of both house forms? The answer to this seems to be affirmative but the evidence is subtle enough that it went unappreciated prior to completion of this study. It will be recalled from Chapter 2 that in comparing the histograms of areas (m^2) of housepits from the right bank housepit cluster with those from 45BN53 in the McNary Reservoir (Figures 2-3 and 2-4) that the former had a higher frequency of slightly larger housepits. This contrast between the right bank housepit cluster and 45BN53 in all probability, is the result of reuse and expansion of some of the larger housepits in the former instance. Subsurface exploration clearly demonstrated that some, but not all, of the right bank housepit clusters contained the later and generally larger, saucer-floored houses superimposed upon depressions from the earlier occupation. The point to be emphasized is that there would probably be remarkable similarity in these two histograms if the later housepit "expansions" or renovations in the right bank housepit cluster could be factored out.

The second component occupations in the right bank housepit cluster were seemingly scattered about rather than continuously present in all adjacent housepits. Test units in a number of adjacent depressions surrounding the very large one (D-48) on the right bank yielded some with salmonid dominated assemblages (D-46, D-47, and D-AA), others with rabbit or antelope dominated assemblages (D-45, D-59, and D-67) and still others that were intermediate to these other assemblages. Given the larger mean size of the later houses, one might expect that many of the early housepits would not have been suitable for reuse by the later occupants without major modifications. The apparent scatter of late occupations in the right bank housepit cluster possibly reflects a preference for certain housepit sizes. This pattern, however, is probably also conditioned by another factor and that is spacing.

Judging from the more dispersed character of the left bank housepits compared to those of the right bank, it would seem that the needs for space by individual households during the second interval of occupation were rather different than those of the earlier site occupants. Assuming this to be the case, reoccupation of depressions remaining from the earlier occupation would involve selection of scattered depressions rather than closely adjacent ones. This kind of pattern of reuse was hinted at in our subsurface explorations in the right bank housepits.

The earlier, steep-walled houses were clearly much more clustered in their distribution. Many occur in groups of four or five or more quite closely clumped together. Pairs of housepits that share a common rim are common and there are groups that occur in circular or rectangular "compounds." While subsurface exploration was too limited to offer much in the way of evidence for relationships between such groups, seven different housepits were tested surrounding D-48. The most definite statement that can be made at this point is that stratigraphic evidence offered no clues indicative of noncontemporaneous initial constructions of these structures. The presence of a sizeable mussel shell feature in D-46 overlying the floor of this structure

suggests that it was a vacant housepit used for garbage disposal by the occupants of an adjacent housepit (probably D-47) during a subsequent occupation. Variations in the numbers of floors in the housepits within this cluster present a similar picture. Both of these observations only emphasize the point made above that the factors conditioning the spacing of households during later occupations were quite different from those that conditioned the spacing of the earlier, steep-walled house occupants.

Turning to another aspect of site structure, some comments regarding the numbers of floors or use levels in various houses across the site are in order. Of particular interest here is an apparent tendency for those housepits nearest the river to contain more floors. Preliminary plotting of densities of faunal and lithic debris versus distance from the river for test units in several houses in the right bank housepit cluster indicated an inverse relationship between densities and distance from river. Numbers of detectable floors or use levels corresponded well with this pattern; the largest number of floors observed occurred in D-47 where at least five were noted, whereas several housepits located towards the interior of the island appeared to have single floors. This pattern would seem consistent with a simple preference for proximity to the river's edge. It does seem to imply, however, that if most or all of the early component structures on the right side of the island were built and occupied simultaneously, then subsequent occupations during the early interval of occupation involved smaller groups of people. Consistent use of structures by very large groups would imply a pattern in which all or most housepits would have similar numbers of floors and probably comparable amounts of debris.

In Chapter 4, Mierendorf suggests a positive relationship between depression size and numbers of use levels. This pattern indeed seems real and must at least partially be accounted for by a preference during the second occupation interval for old depressions requiring the least modification prior to house construction.

A Model for Late Prehistoric Change in Settlement and Subsistence on the Lower Snake (1,400-200 B.P.)

Even though the archaeological deposits from Strawberry Island may span little more than the last 12 centuries of the Late Prehistoric Period, it should be clear by now that we are not dealing with the remains of a single, unchanging cultural system. Whatever the concept of systemic change in hunter-gatherer adaptations one may subscribe to, archaeological data has been presented and discussed that indicates substantial temporal changes in architectural forms, intrasite spatial structure of houses, faunal assemblages, and lithic assemblages. Such changes, especially because they do not accord well with prevailing views of cultural stability throughout the time span represented in the cultural deposits at this site, demand explanation. None have been previously proposed and, in fact, much of the variability recognized at Strawberry Island has not previously been reported from comparable sites.

To this point a case has been developed for the presence of two major episodes of use of this site as a residential base. Both appear to represent the kinds of manifestations expectable from sustained use during a substantial portion of the annual economic cycle. Without assuming that the actual duration of residence in an annual cycle was the same in both cases, it can reasonably be assumed that winter season occupations are represented in both (Cleveland 1978:25-26). In essence, we are dealing with functionally equivalent settlements from two time intervals and both are presumed to have been central nodes in land-use systems that undoubtedly included other seasonal residential camps and special purpose locations. These points all support the belief that we are not "comparing apples and oranges" in the archaeological sense and that, indeed, one would be hard-pressed to identify two more appropriate kinds of comparisons for a consideration of culture change in the archaeological record of hunter-gatherers.

In the terminology of regional archaeology, Strawberry Island is the archaeological ruin of a "housepit village" or "winter village." Interpretations in earlier parts of this report led to the conclusion that we are actually dealing with two housepit villages--one superimposed on the other. The explanatory sequence which now follows focuses specifically upon accounting for the archaeological variability between these two "villages"-- however the term is defined.

A relatively simple model is proposed involving an imbalance between resources and population. This imbalance could be produced either by population increase or by climatic change involving a reduction in the resource/population ratio in the region. Both factors are arguably involved in this case and each will be briefly discussed before considering how their combined interaction would result in changes that can account for those reflected archaeologically.

Until quite recently, the Holocene was divided into three basic climatic regimes (Hansen 1947) and Plateau archaeologists employing this scheme have assumed that the last 4,000 years of the prehistoric record represent an interval of basically modern climate. The upshot of ongoing research on climatic change in the Northwest has not been radical revision of the traditional scheme, but a picture of climatic change that was "somewhat more complex and less uniform in its geographical occurrence than was originally suggested" (Schalk and Cleveland 1983:22-23). It is not too surprising that modern paleoenvironmental research is being directed at climatic change on a more detailed temporal scale and that recent studies increasingly reveal climatic changes of this order that would have, in all probability, had considerable impact upon plant and animal populations and thereby prehistoric human populations. These changes are now coming into focus enough to be of use in understanding late prehistoric archaeology in the Plateau.

Kolva (1975) presents pollen evidence from Wildcat Lake in the Channeled Scablands for the last 2300 years. He concludes that prior to introduction of domestic livestock in the nineteenth century, this entire interval exhibits no fundamental changes in vegetation. Despite

the lack of evidence for significant change in vegetation during the last 2,300 years, however, there is reason to suspect substantial climatic changes of relevance to prehistoric human adaptations of the region did occur during this period.

Bartholomew (1982) has reviewed the literature for evidence of climatic change during the last 1,000 years in the Pacific Northwest and has also analyzed pollen and sedimentary sequences for this interval at Clear Lake, another Scabland lake. A major conclusion of his study and one of particular relevance to the present one was that there was a drought or relatively dry interval between 1,050 and 600 B.P. in this general region (Bartholomew 1982:64). Bartholomew offers the interesting speculation that an apparent decrease in archaeological sites after A.D. 1000 in the canyon of the Lower Snake may relate to these climatic changes. He notes that only one riverine site, Wawawai (45WT39), has revealed radiocarbon dates falling between A.D. 1000 and A.D. 1300 and that one other site, Wexpusnime (Rattlesnake Village:45GA61), probably was occupied after A.D. 1500 though this site lacks radiocarbon dates.

Geological evidence from a recent archaeological study in the Rocky Reach Reservoir provides independent evidence in the form of a change in Columbia River hydrology, possibly related to reduced runoff during the time frame of interest. Based upon dated changes of depositional regime in an alluvial fan and a nearby fluvial bar, Mierendorf (n.d.) assigns this change to sometime after 1,400 B.P. The geological process by which Strawberry Island itself developed as a mid-channel island seems to require a period of greater runoff than today followed by one of reduced runoff that made human occupation and house building a possibility (Mierendorf Chapter 4; Hassan 1977:146).

Considering both global climatological research and a variety of paleoenvironmental data from the Upper Snake River, Butler (1978:41-43) suggests that the general trend in climate over the past 4,000 years has been towards "increasing warmth and dryness, interrupted by cool, moist intervals."

One additional piece of evidence is worth mentioning to further support the picture of climatic conditions presented up to this point. In a study of the distribution of bison remains in the Columbia Plateau, Schroedl (1973) identified 17 dated occurrences of bison in archaeological deposits of the area. Although the author notes that a number of bison remains have been found in archaeological deposits presumed to be less than a 1000 years old, all 17 dated finds fall between 3,380 and 1,025 B.P., the majority of these dates are between 2,500 and 1,500 B.P. (Schroedl 1973:35).

In general then, there are several lines of evidence suggesting a change in climate in the direction of decreased moisture during the general time frame of interest. At least some of these analyses point specifically to the interval between the two major intervals of occupation at Strawberry Island--1,300 to 600 B.P.

When it is recognized that the Pasco Basin lies at the heart of the most arid portion of the Columbia Basin, the importance of reduced precipitation takes on added local significance. This region receives less than five inches of precipitation today and, as Robert Mierendorf has pointed out (personal communication), is the driest area in the entire Northwest and for a considerable distance beyond. Any sustained reduction in mean annual precipitation in this environment would have particularly profound effects. The perennial grasses occurring in this region are at the dry end of their moisture tolerances today and would have greatly reduced distribution with increased aridity (Steve Gill, personal communication). Great reduction of this component of the vegetation would probably exclude ungulates other than pronghorn simply as a result of the lack of adequate forage. These points should suffice in demonstrating the relevance of climatic change as a factor contributing to culture change during the late prehistory of the Lower Snake and as a determinant of measurable variability in archaeological assemblages within this time span.

The impact of climatic shifts in the direction of increased aridity must briefly be considered with respect to human food resources in order that specific consequences for land use can be anticipated. It has already been suggested that the ungulate fauna would be depauperate by the standards of surrounding regions of the Basin. The overall carrying capacity of ungulates is water-regulated in a very direct way in this environment and, therefore, generally low. During drier climatic conditions, ungulate biomass would be depressed even below the rather low levels expectable under conditions like those of today.

Outside the narrow confines of riparian habitats, edible plant resources would also be of very limited abundance. Many of the root resources exploited by aboriginal groups in many areas of the Plateau are, at best, marginal or altogether absent in this region today. Seed resources are poorly known but again likely to be of limited quantitative importance.

Riverine resources, especially anadromous fish, constitute a major resource class that is expected to be least influenced by drier climate. Even anadromous fish productivity probably would be depressed as a consequence of reduced runoff and correlated reductions in the extent and/or reliability of spawning habitat. Given the intercept potential of main-stem fisheries relatively low in the drainage network, however, such reductions would probably not have major local impacts. Even during the driest periods of the Holocene, large numbers of spawners would probably migrate through the main-stem Columbia and Snake on their way to home streams fed by high elevation snow fields. The main-stem Columbia and Snake were also locally important spawning grounds for fall chinook salmon and even if runoff was substantially reduced, these fish would still be present in large numbers. In essence, the Pasco Basin is strategically positioned with respect to migratory fish and would not be impacted by reductions in this resource to the extent that upstream locations might have been. Given an overall reduction in most food resources and especially terrestrial animals and plants, the fish resources would provide one option for compensating

that reduction. To simply maintain a constant level of population in the face of more arid climate, fishing would probably be intensified in the overall subsistence system.

An obvious question arises here with respect to how fishing would increase when this component was already assumed to be a major one long before the interval of interest. Dried fish were presumably a primary factor in making winter sedentism a possibility in this environment and housepit occupations assumed to represent winter sedentism seem to occur by 3,000 years ago (Cole 1968) and perhaps considerably earlier. I am suggesting that the response to increased aridity in this region after 1,400 B.P. would have involved a quantum increase in the degree of dependence upon fish if not the nature of that dependence.

To qualify the argument developed so far, it is important to recognize that climatic change would not by itself seem to be a necessary and sufficient condition to explain the changes reflected archaeologically between 1,400 and 600 B.P. The reason that it is not is that climatic regimes as dry or drier must have occurred during earlier intervals of the Holocene and there is currently no indication of comparable adaptive responses on the part of human populations at those earlier times. If we were to imagine climatic change as the singular cause behind adaptive change we would also have to imagine a cyclical character to adaptive change and this is not compatible with the apparently directional character of the archaeological record. Population increase of a directional nature seems to be the general trend in most archaeological sequences of the world though the rate and nature of that increase were probably highly variable (Cohen 1977). Given higher human population densities at the onset of this particular climatic episode than would have been present during similar intervals earlier in the Holocene, new responses were required. Drier climate, then, is imagined simply as a catalyst that by itself would not be sufficient to produce the adaptive responses proposed. Human population density at adequately high levels in the region is a necessary condition that, when drier climatic conditions are added, become sufficient conditions for triggering adaptive response. The character of that response requires further elaboration.

Assuming that this response was made by populations already practicing a winter sedentary settlement strategy, what changes in strategy beyond increased reliance upon fishing would be involved? Phrased another way, what changes in settlement strategy would be associated with increased dependence upon fishing? The answer proposed in response to this question is pivotal to the entire model presented here.

Hunter-gatherer land use systems have basically two responses to conditions that adversely effect their resource base. They can, on the one hand, exploit larger ranges and simply compensate reductions in productivity by exploiting larger areas. On the other hand, they can intensify resource extractive strategies within a given range to obtain sufficient food. The first alternative would not offer, in this case, a

viable alternative because population levels in the region had achieved high enough levels previously to constrain mobility; winter sedentism is presumed to have developed much earlier in response to precisely such constraints. The second alternative, would be the only possible one and, as already suggested, this would primarily involve greater dependence upon fishing. For approximately half of the year, anadromous fish were unavailable as a resource that could be exploited for immediate consumption so that intensified fishing would imply greater reliance upon delayed consumption.

Greater dependence upon fishing also implies greater dependence upon resources that are relatively clumped in their spatial distributions. Whatever specific techniques are employed, there are very localized physiographic or hydrological settings in which those techniques can be effectively applied. It is not of great importance here to identify what techniques were involved or where precisely on the landscape these techniques were employed. The important consideration with respect to settlement is how greater dependence upon spatially localized resources would effect the kinds and numbers of sites occupied during an annual cycle.

In general, it is expected that increased reliance upon highly localized resources that are exploited both for immediate and delayed consumption would necessitate a reduction in mobility. It is argued here that there are degrees of mobility and variable home range sizes even among hunter-gatherers who practice a logistically organized, winter-sedentary system of land use. A quantum increase in dependence upon fishing is expected to be associated with an increase in the length of time spent annually in a residential site where stored foods constitute the major resource inputs to subsistence. The shift to greater reliance upon fishing as an option for compensating reductions in terrestrial resource productivity would require spending longer periods of time in one or a few locations. It is proposed that climatically triggered changes in food resources in this region would have promoted increased sedentism. Longer portions of the yearly cycle would be spent in a permanent residential base and the number of sites occupied as residential camps would be reduced. In particular, reduction in residential moves would probably involve discontinuance of those moves to residential sites from which animal or plant resources were previously exploited seasonally for immediate consumption.

This model for adaptive response can be summarized briefly. It has been argued that climatically induced reductions in food resources would necessitate greater reliance upon fishing because this component of subsistence would be less adversely effected by drier conditions, because fish resources would offer the best resources suited to intensified exploitation in this environment, and because demographic conditions in the region would preclude the expansion of range as a possible response to resource shortages. Greater reliance upon resources as localized in their distribution (intercept points) as is characteristic of anadromous fish would, in turn, favor a reduction in mobility between seasonally occupied residential camps. A higher degree of sedentism would result in longer occupation at residential bases.

Implications for Archaeological Patterning at Residential Sites

The foregoing arguments can now be linked to differences in the archaeological remains associated with two intervals of occupation at Strawberry Island. In this effort, the purpose is to formulate an explanation for archaeological variability which has deducible consequences and which, therefore, can be tested in future research. No claim is made that the present study itself constitutes a test of the arguments that have been proposed. In considering how archaeological evidence from Strawberry Island conforms to the proposed model, the discussions to follow proceed from the faunal remains, lithics, architecture, and lastly, to site structure.

One of the more obvious expectations that can be generated from a model of increasing sedentism is that longer portions of the year would be spent in residential bases. Given that most food resources have a seasonal component to their availability or with respect to when they can be most effectively exploited, it is expected that longer site occupations would have more diverse faunal assemblages. In terms of assemblage "grain" (Binford 1978:483), a greater degree of sedentism should be reflected by the occurrence of more coarse-grained assemblages at residential bases. That is, there should be more variety in the faunal assemblages associated with more sedentary systems of land use because more food procurement events and more diversity in those events will be represented archaeologically. It will be recalled that the major faunal contrast identified between the two components at Strawberry Island was that the earlier component was strongly dominated by salmonid elements whereas the later component tended to be dominated by rabbit or occasionally pronghorn. The later component also tended to have faunal assemblages that were more diverse or less strongly dominated by any single resource. Both pronghorn and jackrabbit are resources that were probably taken at specific seasons in large numbers through mass harvest techniques and it would appear that these events are much better represented in the later component of the site. While stored food is assumed to have been the primary contributor to subsistence during both intervals, preserved foods appear to have been more exclusively consumed during the earlier interval of occupation. If our assumptions about a late fall-early winter season for pronghorn and jackrabbit drives are correct, the later component represents occupation during that season much more strongly than the earlier component.

Because it has been argued that a trend toward greater sedentism would be associated with increased dependence upon fish, especially stored fish, the higher relative frequencies of salmonid elements in the earlier component of the site seems on the surface a contradiction to the argument. This apparent contradiction can be explained in several ways. For one, the apparent decrease in salmonids in the later component is an expectable consequence of a reduction in relative frequency of salmonids brought about by the greater quantities of mammalian remains. A second factor here may be that changes in the extent of dependence upon stored fish would also require a change in the

techniques for processing fish. Removal of the skeleton, for example, as a part of the preservation process would probably increase the duration of storeability by reducing the probability of spoilage. Given that a shorter period of site occupation is being argued for the earlier component and that this occupation was probably more confined to the colder portion of the annual cycle, I am inclined to suspect that the difference in salmonid remains between the two components reflects a shift towards processing techniques that would insure a longer "shelf life" for stored fish in the later occupation.

Turning to the lithic assemblages and the differences that were identified between them for the two major intervals of site use, the general patterns can be accounted for quite well by the proposed model. A substantial contrast was identified in the debitage frequencies between the two components. It was argued that the later component evidenced more "thrifty" use of cryptocrystalline raw materials. If we imagine that the later occupants of the site spent a longer portion of the year in one location and at this site in particular, it would follow that there would probably also be a concommitant reduction in access or availability of such materials. Whatever the sources, and an alluvial origin is strongly indicated for most of the raw materials in the site, greater sedentism would tend to reduce availability. Increased use of the bipolar reduction technique seems to reflect an increased economy in raw material use in the later component at Strawberry Island. Based upon characteristics of debitage from an earlier housepit site dating between 2,000 and 2,400 B.P. near the mouth of the Palouse River on the Lower Snake (Schalk 1983:166), this temporal trend toward more economical utilization of cryptocrystalline material seems to be a long-standing one.

In regard to the stone tools, higher frequencies of projectile points and cobble spall knives were present in the later component when compared to the earlier. The increased frequency of projectile points was notable and this seems consistent with higher frequencies of pronghorn in the later component. In turn, this frequency difference is consistent with the argument that more food procurement events are presented in the later component because a longer portion of the annual cycle is being sampled for that component at this site. The higher frequency of cobble spall tools in the later component is consistent with the argument above regarding economizing of raw materials if we accept the interpretation that these were functional analogs for utilized flakes, which occur in higher frequencies in the earlier assemblage. Alternatively, if we assume that these tools are related to the processing of fish, their increased frequencies in the later component may reflect the presumed increase in dependence upon stored fish and/or greater reliance upon a processing technique better suited to longer intervals of food storage.

In considering the variability in structural remains identified between the two components at the site, a paradox comparable to that mentioned earlier with respect to salmonid remains emerges. With increasing sedentism and longer intervals of habitation in houses, at a residential base one would tend to expect greater investments in their

construction. While no strong argument can be advanced about the details of house superstructures, it does seem that the more deeply excavated steep-walled structures of the earlier occupation represent larger investments in construction. This suggestion is further supported by the occurrence of sizeable post-molds in association with the steep-walled houses and their apparent absence or scarcity with the saucer-floored structures of the later component. A heavier superstructure with larger structural elements is strongly suggested for the steep-walled houses. How then can the implied differences in house architecture be accounted for in a manner that is consistent with the proposed changes in settlement and subsistence?

Considering variability in house architecture over the past 2,500 years, Nelson (1969) suggests a partial answer:

> The succession of these three house forms, from walled houses with benches to walled houses without benches, to nonwalled houses, suggests a tendency toward structural simplification throughout the Cayuse Phase. It should be mentioned, however, that a simplification in pit form may not entail a simplification in the house superstructure. In fact, the exceedingly large structures sometimes encountered in the Cayuse III period may have required a superstructure more complicated than any of their predecessors (Nelson 1969:99).

This can only be a partial answer, however, because no explanation for the changes are offered. If we assume that the steep-walled structures were occupied for a shorter period of the year and that this period coincided with the colder months, it may be argued that the deeper structures with heavier superstructure would be particularly well-suited to heat retention and insulation from the cold. The same consideration would presumably be important in the design of structures for longer intervals of use by more sedentary people but additional considerations would be added. First, greater sedentism in this case would imply habitation during warmer seasons of the year. Ventilation (and perhaps hygiene) is a factor that would favor shallower housepits and lighter superstructures from which the sides could be lifted or removed during warmer intervals. The use of grass thatch on a light pole-frame structure would seem to offer a means for adjusting to the greater range of temperatures that would necessarily be associated with longer intervals of habitation annually. In the rare instances in which burned houses have been reported archaeologically for the Lower Snake (Leonhardy et al. 1971:4; Yent 1976), grass thatching has been identified.

There is another factor that would also tend to favor a change in house architecture with greater sedentism. Wood would be more precious because longer periods of site use would tend to exhaust local supplies; elimination of the demand for large amounts of wood in house construction may be a response to shortages of this resource. The scarcity of wood suitable even for fuel is especially critical in this very dry region.

In regard to the change in house architecture then, the shift from deeper structures with heavier superstructures to shallower ones with lighter superstructures seems to be consistent with the proposed increase in sedentism. Such a shift would accomodate the need to deal with a greater range of seasonal temperature regimes as well as a growing scarcity of wood for structural elements. The fact that the saucer-floored houses tended to be larger on the average, judging from the below ground evidence, would seem to suggest increasing demand for construction techniques involving smaller quantities of wood.

Turning to differences represented archaeologically in the living floors between the two house forms at Strawberry Island, the evidence is again consistent with the proposed model of an increasingly sedentary land use system. The floors of the steep-walled houses were notable for the paucity of artifacts and debris on them. These floors tended to be difficult to detect even in profile and were characterized by the scarcity of charcoal or organic staining. By contrast, the saucer-floored houses tended to be associated with thick, well-defined, and organically rich lenses covering large central areas of the housepit. Moreover, the quantities of artifacts and debris associated with these floors were generally much greater than those associated with the steep-walled structures. The most reasonable interpretation of these differences would seem to be that the latter house form was associated with longer intervals of use during which more food procurement and processing activities were carried out. Admitting that there is little basis presently for knowing how many distinct annual episodes of house occupation are actually represented within individual "floors", an alternative possibility is that the differences in the nature and amount of debris associated with the floors of the two house forms represent differing frequencies of reuse. That is, the increased quantities of debris in the saucer-floored structures may represent several years of continuous occupation on a seasonal basis as opposed to single year accumulations. If, however, it is assumed that increased density of debris on living floors results from returning to the same residential site on a more regular basis from year to year, then the general argument for increasing sedentism would still seem to hold.

One other possible difference between the archaeological correlates of the two house forms should be mentioned. If the argument for sedentism is generally accurate and we are, in fact, dealing with a shift towards use during a longer period of the year, there are logical consequences for the relative amounts of debris generated during an occupation and its distribution inside and outside of houses. Specifically, one would expect occupations associated primarily with the cold season, during which stored foods were the major source of sustenance, to produce minimal quantities of debris especially faunal remains or materials related to procurement and processing of fresh foods. One would also expect that activities during such occupations would tend to be primarily indoors and that there would, therefore, be relatively small quantities of debris generated by outdoor activities in areas surrounding individual structures. With longer occupations spanning more of the year and a greater degree of fresh food procurement for immediate consumption, however, one would expect relatively greater

quantities of debris to be generated from outdoor activities. Although this possibility has not systematically been investigated with available data as yet, it is my impression that a pattern of this sort would be substantiated.

The last subject to be discussed here has to do with site structure and how differences in durations of seasonal site occupancy would manifest themselves in the general distribution of structures across the site. It has been assumed that most (but not all) of the surficially visible depressions across the site represent actual houses. With the possible exceptions of D-48 which is a strong candidate for a communal structure with a nondomestic function and two other surface depressions that revealed no evidence for house remains below ground when tested (D-114, D-56), most depressions investigated seem to offer evidence for domestic activities.

If the argument for increased sedentism is accurate, there are several characteristics of spatial organization of housepits that may be more understandable. Housepits associated with the early component tend to be densely spaced and often clustered whereas those (the saucer-floored structures) associated with the later component tend to be more widely spaced and show minimal evidence for clustering in small groups. There is some evidence to suggest that this difference in spacing is also reflected in the distributions of late component occupations of old depressions on the right bank of the island. The wide spacing between houses evident for the left bank, in other words, seems to have been maintained in the late component reoccupations on the right bank. This wider spacing between structures may reflect longer site occupancy and correlated needs for interhouse working or activity space or above-ground storage of food and fuel resources. Assuming the earlier component represents primarily a winter season pattern of site occupation during which minimal outdoor processing activities occurred, outdoor space requirements would probably be reduced.

Finally, a reasonable argument can be advanced for the presence of subclusters of housepits that seem to occur in the early component and their apparent absence in the later component. Among hunter-gatherers who aggregate into large winter villages and disperse throughout the remainder of the year into smaller local groups, these smaller economic units tend to maintain their integrity within winter villages. Along the Northwest Coast, for example, the closely related families or lineages that are co-residents at seasonal camps during much of the year live together in the same large, multi-family dwellings or longhouses in the winter (cf. Drucker 1951). The social cohesiveness of families evidenced by the sharing of a common household or by adjacently placed houses in a large winter village is typically conditioned by economic dependencies among those families, social claims to resource procurement sites, and so on. The argument that follows from these observations is that the subclusters of the early component housepits at Strawberry Island may represent economically interdependent and socially related groups of families who maintained a degree of cohesiveness in the spatial positioning of houses in a much larger group of co-resident families in a winter village. With a shift to greater sedentism, the

economic and social discreteness of such groups would be increasingly submerged in the larger co-resident group with which they live for longer portions of the year. Although no claims can be made that archaeological data from Strawberry Island is sufficient to evaluate this argument, it would seem to be the most plausible one available and one that is consistent with the other arguments set forth regarding the nature of change in land use and subsistence.

Discussion

There is one view of the archaeology of the Lower Snake River that historically has been dominant and pervasive. This view holds that the entire prehistoric record of this region is one which reflects no fundamental culture change. According to this view, the archaeological record indicates a conservative accumulation of "cultural traits" or "elements" through time. Like a snowball rolling down hill that grows larger in size while maintaining the same basic form, cultural change is imagined as a sequence of growth without transformation. This perspective can be traced to a number of sources (Shiner 1961:262-263; Caldwell 1956:193, 266; Jennings and Norbeck 1955) but its most persuasive proponent for the Columbia Plateau in general and the Lower Snake in particular has been Daugherty (1962). His "Intermontane Western Tradition" embodies this viewpoint of cultural change:

> Cultural conservatism is a distinctive characteristic of this tradition, with change occurring principally through the addition of new elements (Daugherty 1962:149).

One of the three most salient features of this tradition is

> . . . strong cultural stability with slow gradual (sic) change involving principally the accretion of new elements with little loss or replacement of the old (Daugherty 1962:144).

There can be no doubt about the degree of cultural stability imagined here because even "elements" such as the initial appearance of semi-subterranean houses and later the horse are not considered fundamental in character.

> Throughout the six thousand years of culture history reflected in the nine cultural components of the site, there is no evidence of an abrupt or sudden change, or of drastic change in economic patterns. There is, however, abundant evidence . . . to indicate that the culture hitory of this region was characterized by great stability within the period reflected in the cultural deposits at the site. Cultural change took place gradually, principally by the accretion of new elements and by stylistic changes (Daugherty 1962). Many categories of artifacts show great persistence through time. Until additional data are forthcoming concerning the types of dwellings in use prior to, and associated with, the semi-

subterranean houses, it would be unwise to place great emphasis on supposed cultural changes associated with the adoption of this type of dwelling. Data from Three Springs Bar show no indication that a fundamental change in way of life, seasonal round, or settlement pattern accompanied the introduction and use of the semi-subterranean house (Daugherty et al. 1967:107).

In the protohistoric period, acquisition of the horse (Haines 1938) brought about certain changes in the life pattern of these people. The horse made possible far greater mobility, provided closer contact with the Plains Indian from whom the skin covered tipi was adopted, and probably provided greater trade resources. Archaeologically, these changes and influences are almost impossible to detect at Three Springs Bar in any substantial way. The basic pattern of life and material culture remained largely unchanged until the introduction of Euro-American culture (Daugherty et al. 1967:12 emphasis added).

In an examination of other archaeological studies of the Lower Snake, it is evident that this general perspective has been maintained--especially with respect to the last 2,500 years. It can easily be demonstrated, however, that the nondynamic model of the late prehistory of this region remains an untested assumption and is one that seems increasingly dissonant with the archaeological evidence.

In a phase chronology proposed for the Lower Snake River Region by Leonhardy and Rice (1970:17), for example, it is suggested that "more is known about the earlier cultural manifestations than the later ones." In support of this statement these authors note that only one housepit site (45GA61) had been identified within the last six centuries of the late prehistoric period or the interval they refer to as the "Piqunin Phase" (ibid). Extensive excavations at this single site have been reported only in a cursory way (Leonhardy et al. 1971); there are no radiocarbon dates available from this site and its age has apparently been estimated on the basis of typological comparisons with dated sites[1].

In discussing the archaeological manifestations through the last 2,500 years of the prehistoric record, Leonhardy and Rice (1970) identify seemingly major changes in artifact inventories as well as settlement patterns. The initial occurrence of housepit villages, for example, is first recognized during the interval 2,500-600 B.P. ("Harder Phase"). Although these authors emphasize the need to go beyond a trait list approach in their phase chronology, temporal boundaries are drawn independently of probable shifts in settlement and discussions of archaeological faunal collections are limited to presence-absence statements.

Other archaeological studies have tended to minimize any significant cultural change in the late prehistoric period and have even argued for dismissal of chronological distinctions made by Leonhardy and

Rice in the late prehistoric period (cf. Yent 1976:80; Brauner 1976) on the grounds that there are no changes worthy of recognition as phases in 2,500 years of the cultural sequence leading up to the protohistoric period. A brief examination of how such conclusions are reached is informative about how perceptions of cultural stability have been maintained.

The Wawawai site (45WT39), located in the Lower Granite Reservoir, contained a late prehistoric component, a protohistoric component, and a historic aboriginal component. Based upon tool assemblage comparisons, Yent (1976) attempts to evaluate the nature of late prehistoric culture change:

> The data will be used to test the hypothesis that <u>this late prehistoric period was a stable one without major changes in artifact forms, occupational features, or subsistence</u>. A second hypothesis tested is that it was during the protohistoric period, with the introduction of Euroamerican goods, that the major changes in artifact configuration took place (Yent 1974:4; emphasis added).

The data used to conduct this test seem less than appropriate for that purpose; four radiocarbon dates from the late prehistoric portions of the site all clustered between 760 and 1,190 B.P. and no convincing evidence is offered to indicate that the last five-six centuries of the prehistoric era (the "Piqunin Phase") are represented at the site. Presence/absence comparisons of the artifact assemblages from the protohistoric and historic components of the site revealed that when the Euroamerican artifacts are excluded from this comparison, most artifact forms present in the late prehistoric component are also present in the historic one. The significance of this result, as far as culture change is concerned, seems less than obvious and no consideration is given to relative frequencies of different artifact forms. Nonetheless, Yent (1976:80) concludes that; (1) "there are no changes in the cultural sequence at Wawawai to support the proposed Piqunin Phase," (2) "cultural continuity extends as far back as 2,000 B.P. and data from other sites indicates continuity to 2,500 B.P.," and (3) "major changes become evident only with the introduction of Euroamerican goods." These conclusions obviously raise major questions regarding how assumptions about culture change can be rationalized with archaeological data. Even assuming the adequacy of the procedures utilized for monitoring cultural change, the problem of temporal extrapolation and glossing over of unsampled variability looms large. This problem seems inherent in most of what has been written about the late prehistory of the Lower Snake. One other example illustrates this point but also demonstrates how variability that <u>is</u> potentially represented in individual sites goes unattended.

Major salvage excavations at three sites in the Lower Granite Reservoir have been reported by Brauner (1976). As in the case of Wawawai, the Alpowa sites contain only segments of the late prehistoric record and intervals of many centuries are not represented in the deposits. Again general conclusions are that no significant cultural change is detectable:

> The Alpowa data have documented the occurrence of semipermanent winter villages back into the late Cascade Phase (6000 B.C.-2500 B.C.) and have evoked a theme of cultural continuity spanning the last 6000 years prior to the historic period (Brauner 1976:329).

> . . . the only observable changes in the culture of the Lower Snake River Region from 2500 B.P. to the introduction of the horse were a change in architectural style and the disappearance of the large triangular bladed projectile points. Both events occurred around 1000 B.P. The magnitude of these changes is certainly not worthy of any distinction greater than that of a subphase (Brauner 1976:326).

Ignoring the question of temporal extrapolation for the moment, it is most noteworthy that these conclusions are presented _without any quantitative comparisons of assemblages of differing age_. Artifact collections are simply described, and presented in lists for individual houses and living floors. Activity areas are imaginatively inferred from spatial distributions of artifacts and debris on living floors using an "interpretive base" of Nez Perce ethnography (Brauner 1976:10). In the absence of a theoretical framework for assigning meaning to the spatial distributions of debris on living floors, it is unclear how this study could either support or disconfirm the popular belief that there has been little, if any, significant culture change.

Operating with essentially the same set of assumptions, Lyman's (1976) analysis of the faunal remains from the Alpowa sites dismisses any consideration of temporal patterning:

> . . . fauna processing techniques did not change significantly during the recorded 4,000 to 5,000 year occupation of the Alpowa Locality. Therefore no attempt was made during this stage of the analysis to separate assemblages of faunal remains on the basis of spatial and temporal (archaeological) context. . . . all the artiodactyla remains are considered as a single sample (Lyman 1976:115).

Beyond the theoretical and methodological short-comings in regional archaeology that seemingly sweep most archaeological variability under the rug, there is another major factor that casts doubt on how reliable repeated claims for long term cultural stability may be. This factor has to do with the character of the empirical base upon which studies addressing late prehistoric culture change have been founded. In Table 7-1, I have listed all radiocarbon dates that I am aware of that are directly associated with housepits throughout the last 2,500 years of Lower Snake prehistory. These dates are plotted in Figure 7-1 and examination of their temporal distribution is informative.

The most obvious pattern evident in Figure 7-1 is that the majority of radiocarbon dates fall within clusters from only three sites. Given the predominance of site-oriented studies and an absence

Table 7-1. Radiocarbon dates directly associated with housepits of the Lower Snake River.*

Site	Date B.P.	Sample #	Association
Alpowa (45AS80)	1,330 ± 110	WSU - 1440	House 1, floor
Alpowa (45AS82)	1,250 ± 70	WSU - 1590	House 1, floor
	1,410 ± 80	WSU - 1439	House 2C, rafter
	1,480 ± 80	WSU - 1437	House 3, intrusive pit
	1,810 ± 80	WSU - 1496	House 4, hearth
	1,910 ± 80	WSU - 1497	House 2A, pit
	1,940 ± 60	WSU - 1494	House 4, fill
Wawawai (45WT39)	1,030 ± 90	WSU - 1620	house post
	910 ± 90	WSU - 1621	house post
	760 ± 100	WSU - 1042	house post
	1,190 ± 110	WSU - 1043	house post
Harder (45FR40)	1,525 ± 125	I - 631	Housepit 4, floor 1 hearth
Three Springs Bar (45FR39)	2,760 ± 240	WSU - 430	Early housepit
	Modern ± 127	WSU - 432, 462	Housepit C
	757 ± 187	WSU - 431	Housepit 2
Bone-in-the-Throat (45FR36C)	2,435 ± 65 B.P.	Beta - 1548	Housepit 5, hearth
	2,080 ± 55 B.P.	Beta - 1549	Housepit 2, hearth
Strawberry Island (45FR5)	610 ± 90	WSU - 1698	Housepit D-96
	530 ± 80	WSU - 1699	Housepit D-119
	140 ± 80	WSU - 1899	Housepit D-119
	450 ± 80	WSU - 1890	Housepit D-96
	480 ± 80	WSU - 1891	Housepit D-76
	410 ± 130	WSU - 1893	Housepit D-76
	440 ± 90	WSU - 1894	Housepit D-96
	1,395 ± 80	WSU - 2241	Housepit D-9

*Radiocarbon dates are derived from Kenaston 1966, Daugherty et al. 1967, Brauner 1976, Yent 1976, and Schalk 1983.

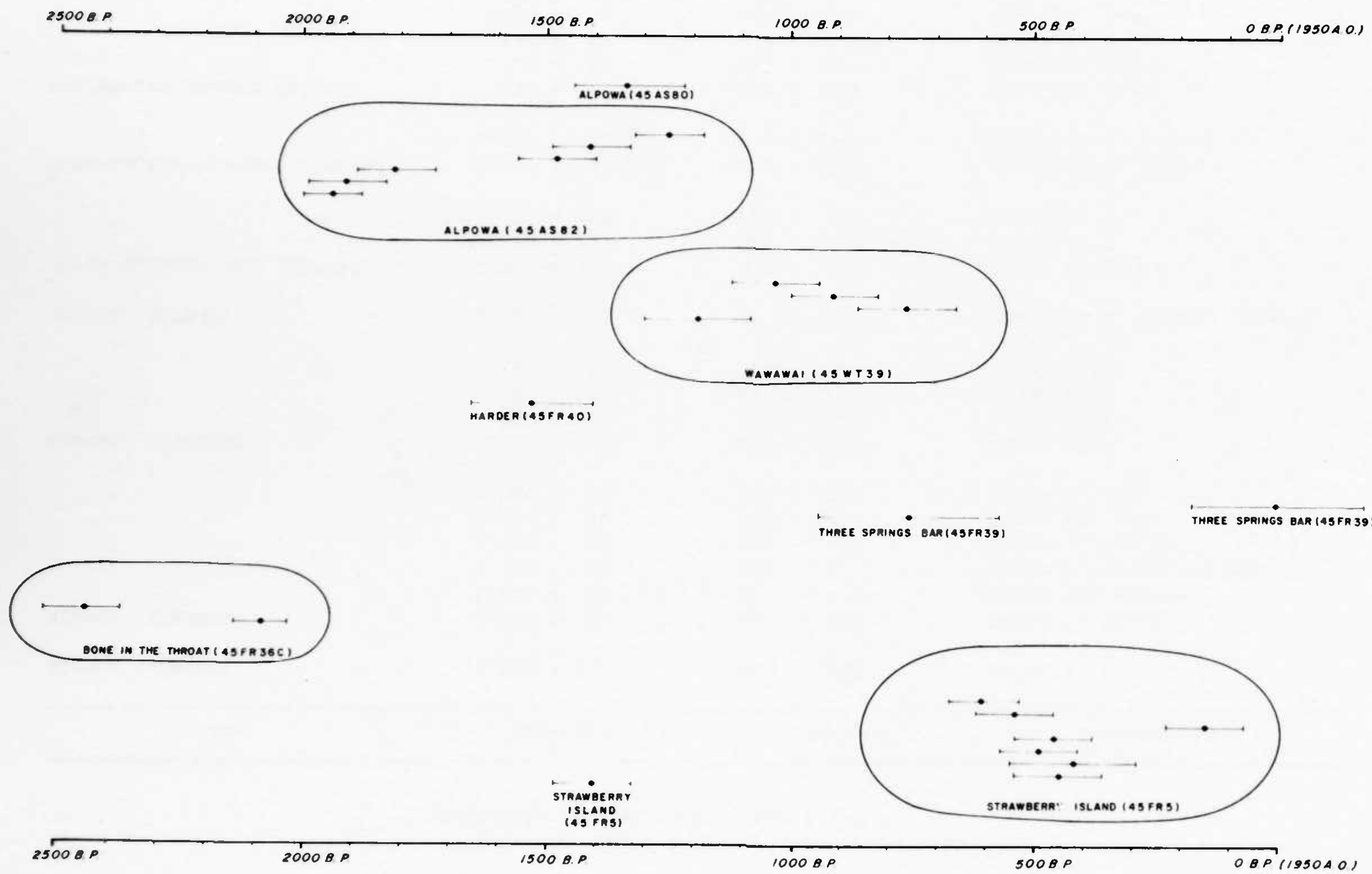

Figure 7-1. Radiocarbon dates associated with late prehistoric housepits of the Lower Snake River.

of intersite analyses of assemblage varibility, there have been no studies that could seriously claim to represent the variability present even in late prehistoric residential sites of the Lower Snake. At best, individual studies have sampled but a very small portion of the temporal range of late prehistory and these segments of time are separated by many centuries for which no archaeological deposits are demonstrably represented. In spite of this fact, the common tendency has been to imagine "continuous sequences" from what are clearly only narrow and markedly discontinuous slices of the record.

Another pattern that stands out in Figure 7-1 is that there are substantial intervals for which there are few, if any, dated archaeological remains of residential sites. The radiocarbon dates on the late occupation interval from Strawberry Island, for example, fall within an interval of more than five centuries for which there are no other dated structural remains. In all probability, the patterns apparent in Figure 7-1 are the result of sampling bias as well as poorly understood changes in subsistence-settlement strategies. Until a more adequate empirical basis for the late prehistoric archaeological record of this region can be established, the repeated claims for long term cultural stasis will remain unsubstantiated. Results of the present study appear to represent a disconfirmation of the conventional view that all cultural changes during this interval were basically superficial.

In reviewing some of the statements that have been made about the nature of the archaeological record of the Lower Snake, an effort has been made to illustrate how assumptions that are deeply embedded in archaeological thinking tend to preclude recognition of significant archaeological variability. Much of the variability that has been documented in the Strawberry Island faunal and lithic assemblages, would have gone unrecognized using the analytical procedures traditionally employed in the archaeology of this region. Heavy reliance upon ethnographic analogy, either explicitly or implicitly, seems to be one symptom of how the research strategies of archaeologists can accomodate tremendous amounts of archaeological variability that can not be anticipated from or explained by an ethnographic model. An assumption that there have been no significant changes in human adaptations during the last 2,500 years has tended to prevent development of approaches to archaeological research that even evaluate the validity of that assumption. It seems clear that a more adequate understanding of the processes of prehistoric culture change will require expanding approaches to spatial organization from the narrow perspective of activity areas and single housepit floors to that which occurs across entire sites and in the distribution of sites across the landscape. Greater attention to the comparative analysis of faunal and lithic assemblages from well-controlled contexts is also of critical importance and this change is already under way.

NOTES

1. The late prehistoric deposits at Rattlesnake Village (45GA61) have been estimated to date between 250 and 550 B.P. (Leonhardy et al. 1971:1). This temporal assignment is apparently based upon typological reckoning. If this estimate is accurate, this site would be roughly contemporaneous with the second major occupation interval at Strawberry Island. The descriptions of house architecture (Leonhardy 1971:Figure 4) and projectile points from Rattlesnake Village suggest either that earlier forms persisted longer at the upper end of the Lower Snake River than further downriver or that the age of some of the housepit deposits at this site has been underestimated by several centuries. Of the six housepits for which cross-sections are shown all but one are the steep-walled forms and the single saucer-floored form (House 7) is interpreted to be the last one occupied.

REFERENCES CITED

Bartholomew, Michael J.
1982 Pollen and Sediment Analyses of Clear Lake, Whitman County, Washington: The Last 600 Years. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

Binford, L. R.
1978 Nunamiut Ethnoarchaeology. Academic Press. New York.

Brauner, David R.
1976 Alpowai: The Culture History of the Alpowa Locality, 2 vol. Unpublished Ph.D. dissertation, Department of Anthropology, Washington State University, Pullman.

Butler, B. Robert
1978 A Guide to Understanding Idaho Archaeology (third edition): the Upper Snake and Salmon River Country. Special publication of the Idaho Museum of Natural History, Pocatello.

Caldwell, Warren W.
1956 The Archaeology of Wakemap Mound: A Stratified Site Near the Dalles on the Columbia River. Unpublished Ph.D. dissertation, University of Washington, Seattle.

Cleveland, Gregory C.
1978 Strawberry Island in Light of Regional Research. In Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington, edited by G. C. Cleveland. Washington Archaeological Research Center, Washington State University, Project Report Number 72. Pullman.

Cohen, M. N.
1977 The Food Crisis in Prehistory. Yale University Press, New Haven.

Cole, David L.
1968 Report on Archaeological Research in the John Day Dam Reservoir Area - 1967. Museum of Natural History, Eugene.

Daugherty, Richard D.
1962 The Intermontane Western Tradition. American Antiquity 28: 144-150.

Daugherty, Richard D., Barbara A. Purdy, and Roald Fryxell
1967 The Descriptive Archaeology and Geochronology of the Three Springs Bar Archaeological Site, Washington. Laboratory of Anthropology, Washington State University, Report of Investigations Number 40.

Drucker, Philip
1951 The Northern and Central Nootkan Tribes. Bureau of American Ethnology, Bulletin 144.

Gifford, Diane P. and A. Kay Behrensmeyer
1977 Observed Formation and Burial of a Recent Human Occupation Site in Kenya. Quaternary Research 8:245-266.

Hansen, H. P.
1947 Postglacial Forest Succession, Climate and Chronology in the Pacific Northwest. Transactions of the American Philosophical Society 37:1-130.

Hassan, Fekri
1977 Stratigraphic and Geomorphological Setting of the Miller Site, Strawberry Island, Appendix 2. In Preliminary archaeological investigations at the Miller Site, Strawberry Island, 1976, a late prehistoric village near Burbank, Franklin County, Washington. Washington Archaeological Research Center, Washington State University, Project Reports 46.

Jennings, Jesse D. and Edward Norbeck
1955 Great Basin Prehistory: A Review. American Antiquity 21(1):1-11.

Kolva, David A.
1975 Exploratory Palynology of a Scabland Lake, Whitman County, Washington. Unpublished Master's thesis, Washington State University, Pullman.

Leonhardy, F. C., G. S. Schroedl, J. Bense, and S. Beckerman
1971 Wexpusnime (45GA61): Preliminary Report. Laboratory of Anthropology, Washington State University, Report of Investigations Number 49.

Leonhardy, Frank, and David G. Rice
1970 A Proposed Culture Typology for the Lower Snake River Region, Southwestern Washinton. Northwest Anthropological Research Notes 4(1):1-29.

Lyman, R. L.
1976 A Cultural Analysis of Faunal Remains from the Alpowa Locality. Master's thesis, Washington State University, Pullman.

Mierendorf, Robert R.
n.d. Cultural Resources of the Rocky Reach of the Columbia. Laboratory of Archaeology and History, Washington State University, Draft Report.

Nelson, Charles M.
1969 The Sunset Creek Site (45KT28) and Its Place in Plateau Prehistory. Laboratory of Anthropology, Washington State University, Reports of Investigations Number 47.

Schalk, Randall
1983 Archaeological Testing of the Prehistoric Site at Lyons Ferry. In Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, near Lyons Ferry, Washington. Laboratory of Archaeology and History, Washington State University, Project Report Number 8.

Schalk, Randall F. and Gregory C. Cleveland
1983 A Sequence of Adaptations in the Columbia-Fraser Plateau. In Cultural Resouce Investigations for the Lyons Ferry Fish Hatchery Project, near Lyons Ferry, Washington, edited by Randall F. Schalk. Laboratory of Archaeology and History, Washington State University, Project Report Number 8.

Schroedl, Gerald
1973 The Archaeological Occurrence of Bison in the Southern Plateau. Laboratory of Anthropology, Washington State University, Report of Investigations Number 51.

Shiner, Joel L.
1961 The McNary Reservoir: A Study in Plateau Archaeology. Bureau of American Ethnology, Bulletin 179, River Basin Surveys 23:149-266. Washington, D.C.

Wood, Raymond W. and Donald Lee Johnson
1978 A Survey of Disturbance Process in Archaeological Site Formation. In Advances in Archaeological Method and Theory, vol. 1, edited by Michael Schiller, pp. 315-318. Academic Press, New York.

Yent, Martha E.
1976 The Cultural Sequence of Wawawai (45WT39), Lower Snake River Region, Southeastern Washington. Unpublished Master's thesis, Department of Anthropology, Washington State University, Pullman.

CHAPTER 8

MANAGEMENT RECOMMENDATIONS

by

Randall F. Schalk

Significance of the Strawberry Island Village

The Strawberry Island Village was listed on the National Register of Historic Places in 1980. As has been suggested in this and other reports, the site is of exceptional scientific value for future archaeological research into any number of current questions in the discipline of archaeology. It has already yielded valuable information on community patterning, technology, cultural responses to climatic change, and site structure; for data regarding these subjects and numerous others in future research, the site is of great value. It has also been suggested that this site represents a type of site that was probably never numerous; between the mouth of the Snake River and The Dalles, Oregon, only two other housepit sites have been reported that were similar to Strawberry Island. One of these sites (45BN53) was completely inundated with the impoundment of the McNary Reservoir. The other, 45KL104, on Miller Island in The Dalles Reservoir, is privately owned and has been subjected to intensive relic digging, cultivation, and erosion. It is possible that comparable sites may still exist relatively intact in the northern portion of the Hanford Reach (e.g., Locke Island), but because the sites in that reach have not been mapped or tested, this possibility is uncertain. Along the Lower Snake River between the mouth and Lewiston, Idaho, there are apparently only two other known housepit sites besides Strawberry Island that remain above water. Both are small housepit clusters, both have been impacted in major ways, and at least one (Lyons Ferry) is considerably older than any of the occupations represented at Strawberry Island. The fact which emerges is that Strawberry Island Village represents an interval of time for which few, if any, other comparable residential sites remain for future investigation throughout this entire region.

Housepit sites of all kinds were once plentiful along the floodplain of the Middle Columbia and Lower Snake. With the completion of all the dams during the past three decades, these sites have been claimed progressively by reservoirs. Due to the fact that preferred locations for winter residences during the past 3,000-4,000 years were largely confined to the floodplain of the major drainage systems, the vast majority are no longer available for further scientific investigation. As in the case of Strawberry Island, the few that remain are generally located at the upper ends of reservoirs where the degree of impoundment was not so great.

Archaeological research at Strawberry Island has produced several lines of evidence suggesting the inaccuracy of a traditional assumption in Plateau Archaeology that there has been minimal cultural change since the initial appearance of housepits in this region more than 3,000 years ago. During the last 1,400 years or more that are represented in this single site, there are substantial and detectable differences in house architecture, size, and spatial organization. In addition, a directional change in faunal remains suggests that there were economic changes associated with these other changes. At least two major intervals of occupation are represented in the site and both are characterized by considerable differences in their form and content.

From the best information available to us, emergence of very large pithouse villages such as the Strawberry Island site first occurred around 1,400 years ago and this appearance is confined primarily to the Middle Columbia area and immediately adjacent areas of the Lower Snake. Important unanswered questions that will undoubtedly be the subject of much future research would include the following:

1. What factors led to the appearance of large villages?

2. Why are these large villages seemingly restricted in their occurrence to the Middle Columbia and immediate vicinity?

3. How does the apparent aggregation of population into large villages relate to the use of the salmon fisheries?

4. In what ways do the apparent changes in subsistence and settlement relate to climatic change and human population increase?

Until quite recently, it has been assumed that climatic changes during the last 4,000 years have been negligible. There is a growing awareness in Plateau archaeology that this interval was characterized by significant climatic changes--particularly relating to changes in precipitation. It now appears that much of the prehistoric human habitation at Strawberry Island and especially the later occupations (1,000-200 B.P.), occurred during a dry interval. The abundance of well preserved faunal remains and dateable organic remains present in the site promise the opportunity to track human responses to climatic changes that occur on the order of centuries or even decades. No other known archaeological site in the Columbia Plateau from this same period of time offers a potential even approaching that of Strawberry Island for research of this sort. Having now excavated only an estimated 3 percent of the site deposits, it should be obvious that the site holds tremendous scientific research value if it can be successfully protected.

There is preliminary evidence to suggest that individual households of roughly contemporaneous age are quite variable as well. The suggestion here is that large housepit sites such as Strawberry Island might be viewed most accurately as complex, internally differentiated communities. Only future research can determine the

extent to which such differences may be related to a division of labor among the various household units within a larger economically and socially integrated group. In short, future management of this archaeological resource cannot realistically embrace a belief that "when you have seen one housepit you have seen them all." The upshot of these points is that management goals for this site should be for preservation of the entire site rather than data recoverery or preservation of some portion of it. The site must be viewed as a village and not a loose assemblage of identical housepits that randomly accumulated in a single area.

It must be emphasized at this point that archaeological sites also have values to the public beyond the scientific. To judge from the programming for public television in recent years and also from the great success of certain popular films, the American public is developing a ravenous appetite for archaeological subject matter. In a study conducted by the Washington State Department of Tourism, it was found that more than 71 percent of the tourists visiting the state listed historic sites at the top of the list of what they want to see (Robert Whitlam, personal communication). These facts are offered in support of the prediction that Strawberry Island Village National Register site will be a major interpretive/educational resource in this region in years to come. The large number of readily visible house remains, the natural setting of the site, and its proximity to eastern Washington's fastest growing and second largest population center are all additional qualities of the site that make it especially suitable for educational and interpretive usage.

On-Going Impacts to the Site

There are four primary sorts of impacts that are occurring on the upper end of Strawberry Island presently. In the order of their relative intensities these include bank erosion and slumping, relic collector activity, recreational impacts, and vegetation growth. Each of these impacts is worthy of further comment.

Erosion and Slumping Impacts

Bank erosion was perceived as a major impact to the site during the 1975 archaological reconnaissance of the Lower Snake River that was sponsored by the Walla Walla District of the Corps. It was primarily this factor but also the possibility of a pool raise with addition of power generating units on McNary Dam that gave impetus to the four seasons of archaeological investigations that have been carried out. In 1975, there were large sediment blocks slumping off the cutbank along the left side of the island. This slumping and erosion was especially noticeable along an area of about 50-60 m of the south side of the island extending upstream from the flood chute that cuts through the island. Quantities of cultural material were observable in the cutbank face where this erosion was occurring. Between 1976 and 1979, numerous

visits to the site by WSU archaeologists indicated progressive erosion and slumping--especially along the lower half of the main channel housepit cluster. In at least one location the cross-section of a house feature was visible in the bank face. Figures 8-1 and 8-2 illustrate the effects of erosion on the site.

The causes for this erosion were identified as being largely from barge traffic and associated waves. In view of the fact that no substantial degree of erosion had apparently occurred between the initial McNary impoundment and the early or middle 1970s, it would seem that factors other than, or in addition to, the normal operation of the reservoir were responsible for an upsurge in erosion processes that was evident in 1975. It is possible that there were increases in the volume of barge traffic brought about at approximately this time by the completion of a system of locks up the Snake to Lewiston, Idaho. Our present evaluation of the erosion occurring on the island is that it is related primarily to barge waves and to a lesser extent, a combination of wind induced wave action and pool level fluctuations. However, a recent archaeological survey (Thoms et al. 1983) in the upper McNary Reservoir above West Richland revealed that erosion was also occurring to certain sites there. Barge traffic can be eliminated as a factor contributing to erosion in that area.

Based upon our own observations, there is increasing evidence that erosion is episodic in nature rather than continuous. For a period of nearly two years, there seemed to be minimal new bank slumping along the main channel shore of Strawberry Island. This led to the premature conclusion expressed in the draft of this report that the erosion process might be achieving an equilibrium condition. Since that time, much new slumping has been observed (Nick Paglieri, personal communication). Reservoir levels were apparently maintained at high levels for a longer period of time during 1981 and/or 1982. From these occurrences and observations in other reservoirs, it seems that major impacts to archaeological sites probably occur during brief intervals when there is a combination of necessary conditions such as reservoir level, wind-induced wave action, and river traffic. The episodic character of bank erosion implies that short-term observation of the process can result in a false sense of security.

In an effort to identify the character of bank erosion occurring on Strawberry Island, large scale aerial photos taken in 1952 and 1976 by the Corps were submitted to RECON Laboratory for comparisons using various image enhancement techniques. The result of this comparison (RECON Laboratory, n.d.) was a demonstration that a substantial margin on both sides of the island has been lost to erosion. Figure 8-3 illustrates the location and extent of erosion along the shoreline of the site. From this photogrammetric investigation it appears that at least 10 housepits were completely lost and portions of another five housepits suffered major erosion impacts. On-site observations by WSU archaeologists indicate that the process of erosion has advanced considerably since 1976.

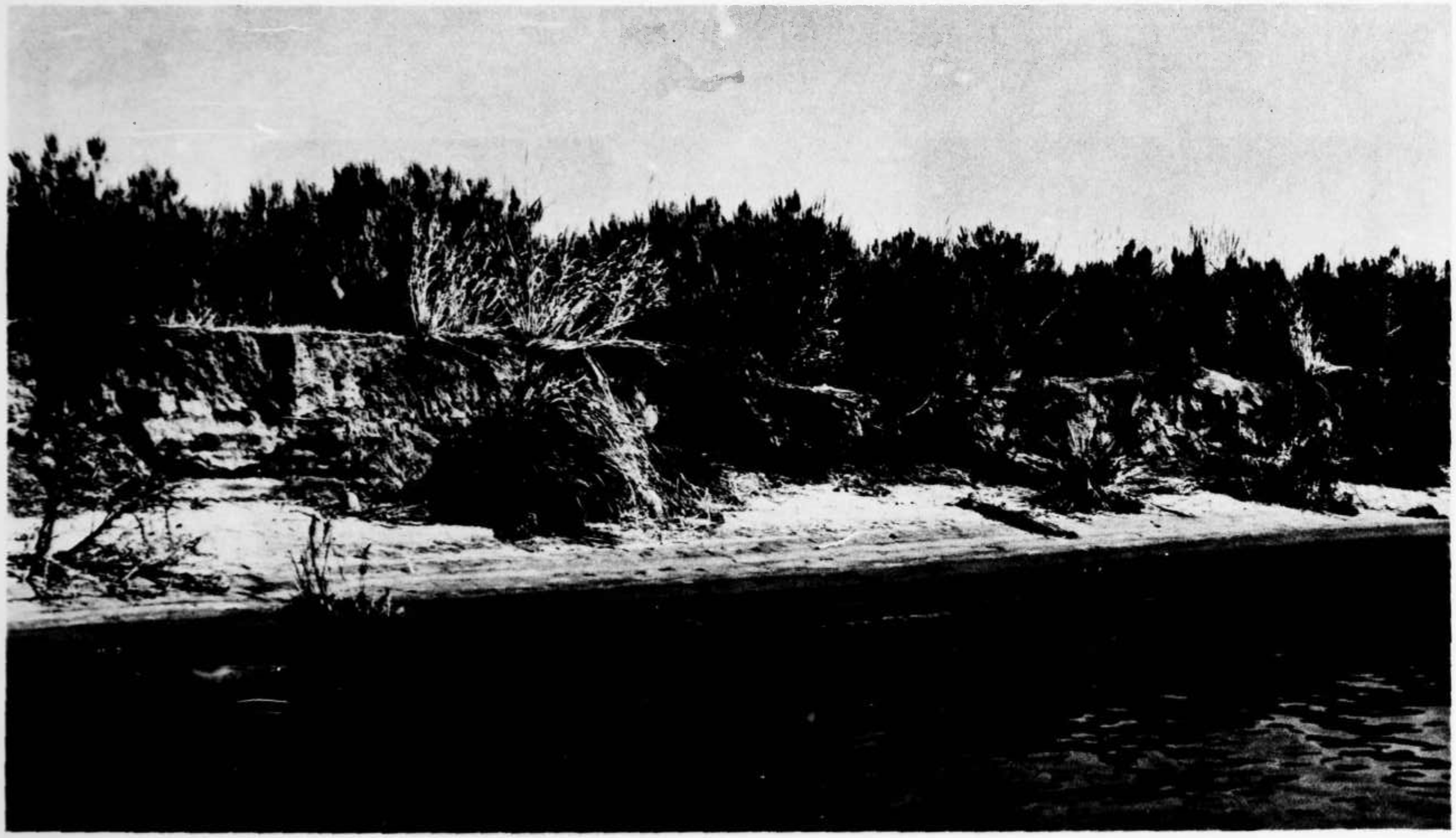

Figure 8-1. Photograph of effects of erosion on left bank of the island (main channel side), showing large blocks of sediments slumping off. An eroding housepit is visible as a depression at the right center of photo (photo courtesy of US Army Corps of Engineers).

Figure 8-2. Photographs of effects of erosion on the left and right banks of the island.

A. View downstream along right bank showing large blocks of sediments slumping off.

B. View downstream showing lag deposits on beach and slump blocks along cut bank at right.

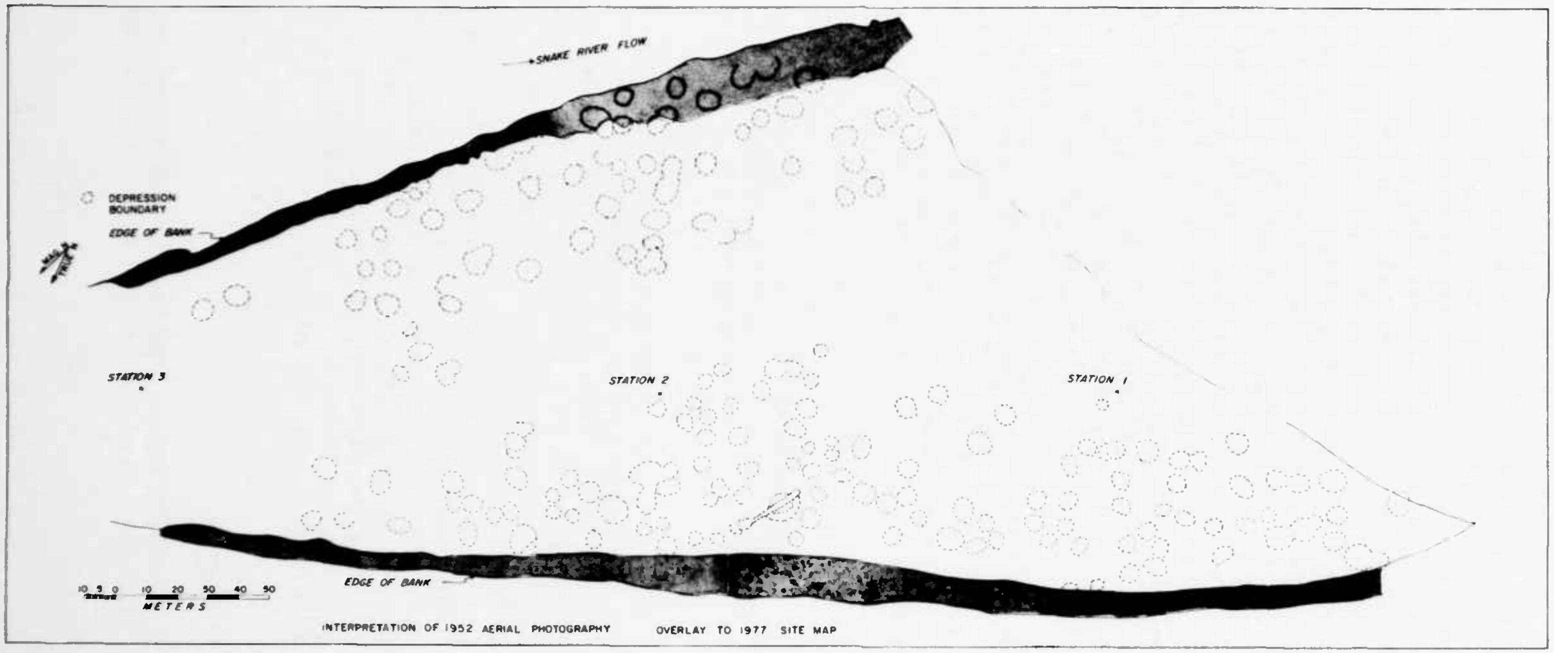

Figure 8-3. Map illustrating the location and extent of erosion along shoreline of the site.

Reservoir Induced Vegetation Changes As Impacts

The second kind of impact to the site is related to changes in its surface vegetation. Compared to the present-day vegetation cover on the island, photographs of the site taken in 1951 show that it was then much more sparsely vegetated (compare Figure 8-4A and 8-4B). The island was then dominated by grasses and annuals with few sagebrush. Today giant sagebrush, wild rye, and a wide variety of weeds occur across much of the island. The causes for this change in vegetation are undoubtedly due in part to the raise in water table with the impoundment of McNary Reservoir. The level has been raised approximately 8-10 feet from its prereservoir level. The other factor is that the island was intermittently burned in earlier years to remove predator habitat and this technique is no longer used. Whatever the causes, the result is probably greater biologic activity in the sediments with possible effects on perishable materials in the site deposits. The extensive root systems associated with sagebrush and wild rye probably also result in some disturbance to archaeological materials and sediments. Statements regarding this impact have been made in previous reports:

> Another high-impact process affecting the village midden is the fluctuating water table, at a higher level (mean reservoir 345') since the impoundment of water behind McNary Dam in 1953. This phenomenon has had a variable effect on the archaeological record here by raising the saturation zone or capillary fringe (see Mierendorf 1977) resulting in an increased attrition rate of the organic component (mainly bone by density) of the site. The detrimental effects of increased plant growth, especially species such as *Artemesia tridentata* and *Elymus cinerus*, both of which have substantial subsurface root systems, also have accelerated with the rise in water (Cleveland 1978:2).
>
> The effects of a high water table are minimal with respect to immediate development of organic matter *in situ*. Under more optimum conditions than presently exist on the island, Birkeland (1974:163) notes that organic matter accumulationn requires several hundreds of years minimally. Of more direct concern is the increased physical penetration of cultural features by roots. Particularly troublesome during excavation was the concentrated root system of giant wild rye (*Elymus cinerus*) which rendered conventional trowel techniques impractical. These root systems permeated cultural features and their contents of charcoal, bone and shell, thus alterating conditions conducive to the preservation of cultural material (Mierendorf 1977:115).

Relic Collector Impacts

Relic collector activity has been recognized as the third kind of impact that is occurring at Strawberry Island. A number of the

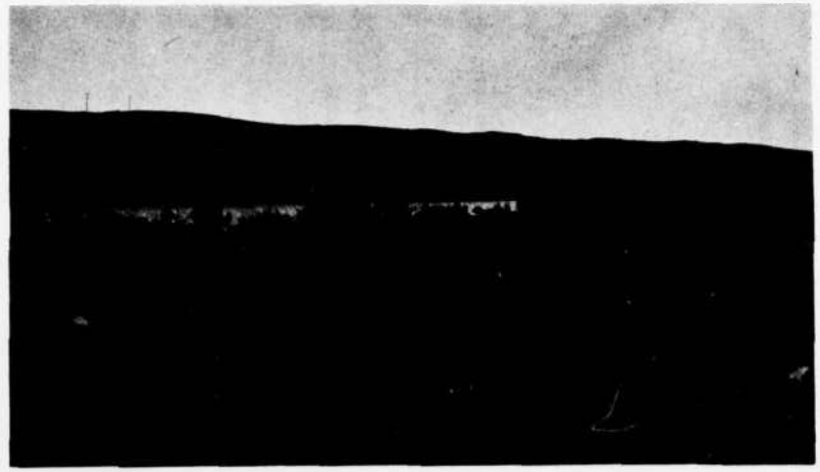

Figure 8-4. Photographs illustrating change in vegetation associated with construction of McNary Dam.

A. 1951 photograph of D-48A, view southward (photo courtesy of Archive of Pacific Northwest Archaeology).

B. 1979 photograph of same area with crew members standing in depressions surrounding D-48A, view northward.

C. 1978 photograph of giant sagebrush in vicinity of D-128.

housepit depressions across the site have had exploratory potholes placed in their centers over the years and some quite recently. Depressions 1, 3, 8, 12, 34, 37, 39, 72, 79, 87, 88, 89, 101, 102, and 104 all exhibit visible potholes. Due perhaps to the relatively low yield of projectile points or other stone items most valued by collectors, these excavations have fortunately been abandoned before any extensive areas were disturbed. Nonetheless, relic collector impacts represent a continuing threat to the integrity of the site deposits.

Recreational User Impacts

A fourth kind of impact that has been observed on the site is associated with recreational usage of the island. Despite the fact that the Corps has discouraged such usage, due to its status as waterfowl and wildlife habitat, there is an almost daily usage of the island by water skiers during the summer. While much of this skier activity is confined to the beach area around the margin of the island, the site surface is utilized by boaters as a rest area. The island is also utilized intermittently during the summer for weekend "keg-parties." Observations of the abandoned camp areas after such parties indicate that these overnight visits include latrine trenches, garbage pits, and campfires. In general, recreational usages of the kinds described are undoubtedly impacting the archaeological deposits which are only 5-6 in. below the ground surface.

Recommendations

It is recommended that Strawberry Island Village be given all possible protection as an important cultural resource that has great scientific, interpretive, and educational value. As a property listed on the National Register of Historic Places, the site is entitled to full protection under the law. In the preceding sections of this report, the major impacts presently occurring to the site have been identified and described. It is assumed that data recovery excavations are not a serious consideration as a means of mitigating these impacts. Very extensive excavations would be required to adequately recover the kinds of information which make this site significant. Data recovery, even if it could be adequately funded, would preempt the long-term potentials of this site to benefit the public in any number of ways.

The following recommendations are offered as reasonable responses to the impacts that are occurring at the site.

Prevent Further Bank Erosion

Bank erosion clearly represents the most destructive impact presently occurring at the site. Measures should be taken to stabilize the margins of the island. From conversations with engineers of the

Walla Walla District of the Corps, it is our understanding that rip-rapping or some similar technique may be the only effective way to prevent further erosion. Before a rip-rapping project is implemented, however, there are things that should be considered. The first involves a careful examination of where and how erosion is occurring around the margins of the island. This examination can probably best be done with aerial photographs which can provide a time sequence picture of the erosion process. The Corps not only has high quality photographic imagery of this sort spanning more than 30 years but also has the photogrammetric hardware to make precise interpretations of that imagery. Thoughtful planning in the light of a thorough understanding of exactly where and how the erosion is occurring will likely increase the probability that the protective measures will be accomplished in the most effective manner. In a preliminary way, Figure 8-3 provides a picture of erosion impacts to the site as of 1976. The shaded areas in this figure represent the portions of the island lost to erosion between 1952 and 1976. Assuming that the photographic interpretations involved in the production of this map are accurate and that the erosion process has proceeded in a similar manner since 1976, the areas of the island requiring stabilization would correspond to these shaded areas.

The second consideration and one that would probably follow from the preceding one is that various techniques available for bank stabilization be evaluated in terms of their probable effectiveness <u>under the local conditions</u>, cost, and multiple resource usage. Since the Island is anticipated to have long-term educational and interpretive usage and is a National Register site, due consideration should also be given to aesthetics associated with various protective measures. Representatives of the Corps have stated that the bank of the island can not be rip-rapped directly because this would interfere with use of the island by geese and wildlife. Instead, a low rock berm paralleling the island margin at a distance of several feet offshore would be necessary.

Because the Corps of Engineers is uniquely qualified to make determinations of what techniques will be most appropriate in this instance, it must be assumed that the rock berm technique will, in fact, work to halt further erosion and that less ambitious measures (e.g., banking of dredge spoils or gravel against the cutbanks around the island margins) have already been evaluated and deemed inappropriate.

If, for any reason, the Corps should decide to place rip-rapping materials directly against any portion of the archaeological deposits of the site, all possible precautions should be taken to insure that this be done without further impacts to the site. That is, if the low rock berm of off-shore rip-rap is not utilized all around the site and rock fill is placed directly against areas of fine-grained sediments along the cut-bank, further impacts could occur from the compaction of archaeological materials or from subsequent erosion between the interstices of the boulders. Cochran (Miss and Cochran 1982:120-121) provides a detailed description of measures appropriate to insuring this effectiveness of protective rip-rapping. This description should be consulted if there will be any direct placement of rip-rapping on or against the cut-bank of the island itself. To this it should be added

that heavy equipment and vehicles of any sort should not be operated on any portion of the archaeological site. If implementation of protective measures involves either impacts from heavy equipment or from alteration of the bank, data recovery at specific localities may be necessary. However details of the exact protective measures are worked out, it is important that protective actions be taken as soon as possible.

Enforce the Laws Protecting Cultural Resources

The island will continue to suffer the depredations of relic hunters if the laws protecting cultural resources on public lands are not strictly enforced. All forms of digging, scratching, and collecting must be prohibited. Corps rangers spend much of their time in the vicinity of the island--either at Hood Park or at Ice Harbor Dam. These individuals should be well-informed about the proper procedures for making arrests of individuals violating laws pertaining to cultural resources. They should also be knowledgeable about the laws themselves as well as how to collect evidence of a violation. If the rangers are not already familiar with these matters, the Corps District archaeologist should be responsible for providing them with the necessary background information. Also, there are now federal cultural resource law enforcement training sessions that are held regularly. Corps rangers and project personnel should be provided opportunities to attend such training sessions if they have not done so previously.

The island should be monitored regularly by rangers or other Corps personnel and this can be done quite easily (using field-glasses from the shore) without having to visit the island. To insure that this monitoring effort is effective, periodic visits to the island by the Corps archaeologist should be made to inspect for recent signs of disturbance. When such disturbances are found, monitoring efforts should be intensified.

Prohibit Over-Night Boat Camping on the Island

If recreational use of the island is not entirely prohibited, then signs should be posted at close intervals around the island. These signs should state that the island is off-limits to camping, fire-building, latrine digging, or any other ground disturbing activities. If the existing camping and restroom facilities at Hood Park and other locations in the vicinity are not sufficient to fill the needs of boaters, then consideration should be given to development of camp-sites and pit-toilets on lower Strawberry Island. Corps rangers should regularly monitor the island with special attention to the Fourth of July weekend, the annual hydroplane races, and summer weekends in general.

AD A132 291 THE 1978 AND 1979 EXCAVATIONS AT STRAWBERRY ISLAND IN THE MCNARY RESERVOIR(U) WASHINGTON STATE UNIV PULLMAN LAB OF ARCHAEOLOGY AND HISTORY R F SCHALK ET AL. 1983

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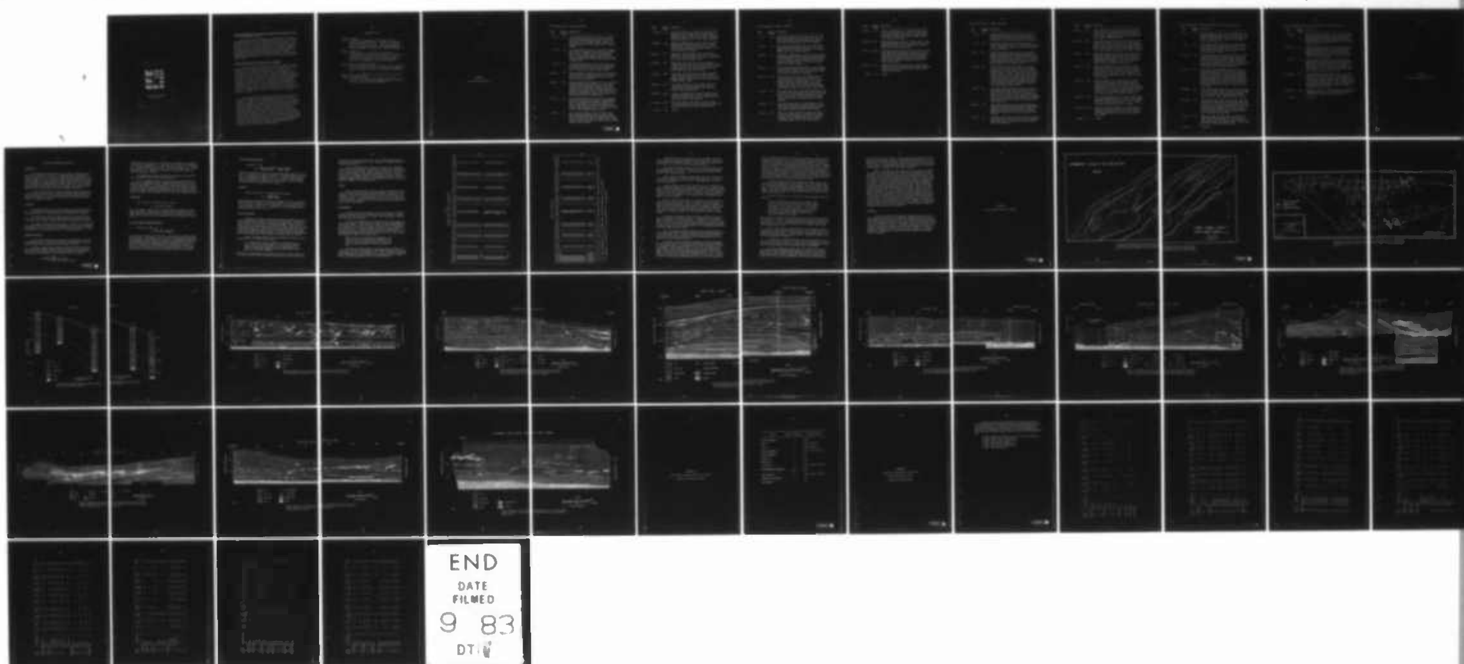

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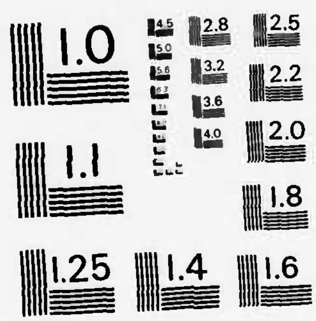


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Coordinate Management of the Island's Archaeological Resource with the U.S. Fish and Wildlife Service

Strawberry Island is presently a valuable habitat for waterfowl and wildlife and is under the management jurisdiction of the U.S. Fish and Wildlife Service. To date, it would appear that management of the island's wildlife is quite compatible with and in the best interest of the cultural resource that is present there. Nonetheless, management activities such as rip-rapping, posting of signs, vegetation control, and regulation of recreational usage are ones which may require close cooperation between the Corps of Engineers personnel, including archaeologists, and the US Fish and Wildlife Service to insure that the needs of both archaeological and wildlife interests are given adequate consideration.

Maintain Vegetation at an Early Stage of Succession

The giant sagebrush growing in dense stands across the island along with wild rye should be controlled if not completely removed from the site area. Both have deep root systems that hasten bone deterioration and probably modify subsurface relationships between archaeological materials. In addition, these plants offer cover and concealment for relic digging. Neither species is likely to enhance the value of the island as goose habitat. Prior to taking steps to control these species, however, the U.S. Fish and Wildlife Service should be consulted. Assuming that there is concurrence regarding desirable vegetation for the island, it is recommended that the sagebrush be eliminated through the use of fire. Any cutting or clearing of brush should be done so as not to disturb subsurface deposits. Periodic burning of the upper portion of the island, if done at the proper season of the year, should maintain the island predominantly in grasses, annuals, and forbs.

In conclusion, the Strawberry Island Village National Register site has been argued to be an exceptionally significant site for scientific, intepretative, and educational purposes. It is currently undergoing a number of attritional processes that threaten its long-term survival. Specific recommendations have been offered in this chapter which, if implemented, would substantially reduce the adverse impacts that are presently occurring. If there is any possibility that mitigative measures themselves could further impact the site, the Washington State Office of Historic Preservation and/or professional archaeologists should be consulted. Because most of the house remains and the other important areas of the site closely parallel the shoreline of the island, continuing impacts from erosion, root disturbances, and recreationists threaten to destroy the site. It must be recognized that the loss of the scientific, educational, and interpretative values present on this site could be complete and definitely would be irreversible if actions are not taken promptly.

REFERENCES CITED

Cleveland, Gregory C.
1978 Introduction. Second Annual Interim Report on the Archaeological Investigations at the Miller Site (45FR5) on Strawberry Island (1977), A Late Prehistoric Village Near Burbank, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 72.

Mierendorf, Robert R.
1977 Sediment Analysis. In Preliminary Archaeological Investigations at the Miller Site, Strawberry Island, 1976, A Late Prehistoric Village near Burbank, Franklin, County, Washington. Washington Archaeological Research Center, Washington State University, Project Report Number 46.

Miss, Christian J., and Bruce D. Cochran
1982 Archaeological Evaluations of the Riparia (45ST1) and Ash Cave Sites on the Lower Snake River. Laboratory of Archaeology and History, Washington State University, Project Report Number 14.

Thoms, Alston V., Sheila Bobalik, Karen Dohm, Todd R. Metzger, Deborah L. Olson, and Stephan R Samuels
1983 Archaeological Investigations in Upper McNary Reservoir: 1981-1982. Laboratory of Archaeology and History, Washington State University, Project Report Number 15.

APPENDIX A

Key Profile Descriptions

Profile Description 1 from D30, 60S/111W

Depth	Stratum & Unit	Description
0-5 cm	Ia	Light brownish gray (10YR 6/2.5d) very fine sandy loam, very dark grayish brown (10YR 3/2m); weak, very fine and fine granules grading to weak, very fine plates; soft, friable, slightly sticky, low plasticity; many, very fine roots; clear, irregular boundary.
5-7 cm	Ib	Pale brown (10YR 6.5/2.5d) silt loam, dark grayish brown (10YR 4/2m); weak, very fine plates; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, broken boundary. Note: occurs in thin discontinuous lenses; has few, irregular brownish (7.5YR hue) mottles due to oxidation from heat.
7-10 cm	Ic	Grayish brown (10YR 5.5/2.5d) very fine sandy loam, very dark grayish brown (10YR 3.5/2m); weak, very fine plates; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt, wavy boundary.
10-13 cm	Id	Light brownish gray (10YR 6/2.5d) silt, dark grayish brown (10YR 4/2m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, wavy boundary.
13-40 cm	IIa	Grayish brown (10YR 5/2d) sandy loam, very dark grayish brown (10YR 3/2m); massive; few, fine, white (8/0d) vertically oriented tubular mottles of salt efflorescence; slightly hard, friable, nonsticky, nonplastic; many, very fine and common, medium roots; gradual, wavy boundary. Note: fire-broken rocks, pebbles, and mammal bone fragments are common, krotovinas and decayed root channels occur.
40-71 cm	IIb	Grayish brown (10YR 5.5/2.5d) sandy loam, dark grayish brown (10YR 4/2.5m); massive to single-grained; few, fine, prominent, white (8/0d), vertically oriented, tubular mottles of salt efflorescence; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt, broken boundary. Note: two bands at 40 and 60 cm of thin discontinuous silt lenses.
71-80 cm	IIc	Very pale brown (10YR 7/2.5d) silt, dark grayish brown (10YR 4/2m); massive; few, irregular, faint, dark yellowish brown (10YR 4/4m) and very dark grayish brown (10YR 3/2m) mottles; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, broken boundary.

Depth	Stratum & Unit	Description
80-98 cm	IId	Light gray (10YR 7/2d) fine sand to fine sandy loam, dark grayish brown (10YR 4/2m); single-grained to massive; loose to slightly hard, friable, nonsticky, nonplastic; many, very fine roots; abrupt, irregular and broken boundary. Note: very loosely compacted.
98-103 cm	IIe	Light gray (10YR 6.5/2d) very fine sandy loam, dark grayish brown (10YR 4/2m); massive; soft, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, smooth and irregular boundary. Note: scattered flecks of charcoal.
103-110 cm	IIf	Light gray (10YR 7/2d) sand, dark grayish brown (10YR 4/2m); single-grained; loose, loose, nonsticky, nonplastic; many, very fine roots; abrupt, wavy boundary. Note; few fire-broken rocks.
110-118 cm	IIIa	Light gray (10YR 7/2d) silt, dark grayish brown (10YR 4/2m); weak, very fine and fine angular blocky; mottled pale brown (10YR 6/3d); slightly hard, friable, slightly sticky, low to moderate plasticity; many, very fine roots; abrupt, wavy boundary.
118-123 cm	IIIb	Pale brown (10YR 6/3d) silt loam, dark brown (10YR 3/3m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, smooth boundary. Note: mottled with discontinuous, diffuse charcoal stains.
123-130 cm	IIIc	Pale brown (10YR 6.5/2.5d) fine sandy loam, brown (10YR 4/2.5m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, smooth boundary.
130-137 cm	IIId	Light gray (10YR 7/2.5d) very fine sandy loam, dark grayish brown (10YR 4/2m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, wavy boundary.
137-144 cm	IIIe	Pale brown (10YR 6/2.5d) sandy loam, brown (10YR 4/2.5m); massive; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt, broken boundary.
144+ cm	IV	Gravels.

Profile Description 2 from D9, 119S/150W

Depth	Stratum & Unit	Description
0-5 cm	Ia	Grayish brown (10YR 5/2d) fine sandy loam, very dark brown (10YR 2/2m); weak to moderate, very fine granular; soft, friable, nonsticky, nonplastic; many, very fine and medium roots; clear, wavy boundary.
5-10 cm	Ib	Very pale brown (10YR 7/3d) silt, very dark grayish brown (10YR 3/2m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine and medium roots; clear, broken boundary.
10-15 cm	Ic	Grayish brown (10YR 5/2d) fine sandy loam, very dark grayish brown (10YR 3/2m); massive to weakly expressed, very thin laminae of mica flakes grading upward into very fine laminae of organic remains; soft, friable, nonsticky, nonplastic; many, very fine and medium roots; clear, wavy boundary.
15-24 cm	Id	Light brownish gray (10YR 6/2.5d) silt to silt loam, very dark grayish brown (10YR 3/2m); massive; slightly hard, friable; slightly sticky, low plasticity; many, very fine roots; abrupt, wavy boundary.
24-75 cm	IIa	Grayish brown (10YR 5.5/2.5d) fine sandy loam, very dark grayish brown (10YR 3/2.5m); massive; soft, friable, nonsticky, nonplastic; many, very fine to medium roots; clear, wavy boundary. Note: fire-broken rocks, river rounded pebbles and cobbles, scattered charcoal flecks, stone tools, and mammal bone fragments common; two discontinuous silt bands.
75-85 cm	IIb	Light gray (10YR 7/2d) to pale brown (10YR 6/3d), very fine sandy loam, dark grayish brown (10YR 4/2m); massive to weak, angular blocky; slightly hard, friable, slightly sticky, low to moderate plasticity; many, very fine and common, medium roots; clear, broken boundary.
85-90 cm	IIc	Light gray (10YR 6.5/2d) fine to medium sand, dark grayish brown (10YR 4/2m); single-grained; loose to soft, loose, nonsticky, nonplastic; many, very fine and common, medium roots; clear, wavy boundary.
90-93 cm	IIIa	Light gray (10YR 6.5/2.5d) silt loam to very fine sandy loam, dark grayish brown (10YR 4/2m); massive to weak, very fine angular blocky; soft, friable, slightly sticky, low plasticity; many, very fine and common, medium roots; clear, wavy boundary.

Depth	Stratum & Unit	Description
93-96 cm	IIIb	Pale brown (10YR 6/3d) silt loam, dark brown (10YR 3/2.5m); weak to moderate, very fine to coarse angular blocky; slightly hard, friable, slightly sticky, low plasticity; many, very fine and common, medium roots; clear, wavy boundary.
96-103 cm	IIIc	Light brownish gray (10YR 6.5/2.5d) fine sandy loam, dark grayish brown (10YR 4/2m); massive; soft, friable, nonsticky, nonplastic; many, very fine and common, medium roots; clear, wavy boundary.
103-113 cm	IIId	Light grayish brown (10YR 6.5/2.5d) silt loam to very fine sandy loam, dark grayish brown (10YR 4/2m); massive to weak, very fine angular blocky; few, fine, faint high color value mottles of salt efflorесence; slightly hard, friable, slightly sticky, low plasticity; many, very fine and common, medium roots; clear, wavy boundary.
113-131 cm	IIIe	Light gray (10YR 7/1.5d) medium sand, grayish brown (10YR 4.5/2m); single-grained; loose, loose, nonsticky, nonplastic; many, very fine and few, common roots; abrupt, wavy boundary.
131+ cm	IV	Gravels.

Profile Description 3 at D128, 58S/43.50E

Depth	Stratum & Unit	Description
0-4 cm	Ia	Grayish brown (10YR 5/2d) silt loam, very dark grayish brown (10YR 3/2m); weak, very fine granular; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; smooth, clear boundary.
4-10 cm	Ib	Pale brown (10YR 6/3d) silt, dark grayish brown (10YR 4/2m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, irregular boundary.
10-37 cm	IIa	Grayish brown (10YR 4.5/2d) sandy loam, very dark grayish brown (10YR 2.52/m); massive; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; gradual, wavy boundary. Note: contains discontinuous bands of brown (10YR 5/2.5d) sandy loam that is uncompacted and has weakly expressed, cross-bedded laminae; few fire-broken rocks.
37-70 cm	IIb	Brown (10YR 5/2.5d) very fine sandy loam to sandy loam, very dark grayish brown (10YR 3/2m); massive; slightly hard, friable, nonsticky, nonplastic; many, very fine and few, coarse roots; abrupt, wavy and irregular boundary. Note: a prominent, very dark gray (10YR 3/1d) to black (10YR 1/1m) "floor zone" which contains few, distinct, irregular light brown (7.5YR 6/4d), dark brown (7.5YR 3/2.5m) oxidation mottles; fire-broken rocks, mammal bone fragments, charcoal flecks, and siliceous stone fragments; the lower 13 cm is mottled brown (10YR 5/2.5d).
70-80 cm	IIc	Light brown (10YR 6.5/2.5d) fine sandy loam, dark brown (10YR 3/3m) grading laterally into a very dark gray (10YR 3/1d), black (10RY 1/1m) "floor zone"; massive; soft, friable, nonsticky, nonplastic; many, very fine and few, coarse roots; abrupt, wavy boundary. Note: poorly preserved, powdery fish bones; irregular, light brown (7.5YR 6/4d), dark brown (7.5YR 3/2.5m) oxidation mottles.
80-83 cm	IId	Brown (10YR 5/2.5d) sandy loam, dark grayish brown (10YR 3/2m); massive to single-grained; common, medium, irregular, brown (10YR 5/2.5d) mottles of fine and medium sand; soft, friable, nonsticky, nonplastic; many, very fine and few coarse roots; abrupt, wavy boundary.
83-91 cm	IIe	Light gray (10YR 6.5/2d) fine sandy loam, dark grayish brown (10YR 4/2m); massive; soft, friable, nonsticky, nonplastic; many, very fine and few, coarse roots; clear, wavy boundary.

Depth	Stratum & Unit	Description
91-112 cm	IIIa	Light gray (10YR 6.5/2d) sandy loam to sand, grayish brown (10YR 4.5/2m); massive; few, fine, faint, irregular, very dark grayish brown (10YR 3/2m) mottles; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt, irregular boundary.
112-120 cm	IIIb	Light gray (10YR 6.5/2.5d) very fine sandy loam, dark grayish brown (10YR 4/2m); massive to weak, angular blocky; soft, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, wavy to smooth boundary. Note: many, fine, faint, higher color value mottles of salt efflouresence; occurs as a parallel or wavy bed.
120-135 cm	IIIc	Light gray (10YR 7/1.5d) sand to sandy loam, grayish brown (10YR 5/2m); single-grained; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt, smooth and broken boundary. Note: few diffuse oxidation mottles on individual grains recognized by higher chroma; scattered charcoal flecks.
135-145 cm	IIId	Light gray (10YR 7/2d) very fine sandy loam, dark grayish brown (10YR 5/2m); massive to weak, angular blocky; soft, friable, slightly sticky, low plasticity; many, very fine roots; abrupt, smooth and broken boundary. Note: many, fine, faint, higher color value mottles of salt efflouresence; occurs as a parallel to wavy bed.
145-170 cm	IIIe	Light gray (10YR 7/1.5d) medium sand, gray (10YR 5/1.5d); single-grained; common, medium, distinct, pinkish gray (7.5YR 7/2d), brown (10YR 5/2m) irregular oxidation mottles; loose, loose, nonsticky, nonplastic; many, very fine roots; abrupt, wavy and broken boundary. Note: diffuse to compact mottles of charcoal flecks; some individual reddish yellow (7.5YR 7/6d) to strong brown (7.5YR 5/6d) sand grains.
170-175 cm	IIIf	Very pale brown (10YR 6.5/2.5d) very fine sandy loam, dark grayish brown (10YR 4/2m); massive; soft, friable, nonsticky, nonplastic; many, very fine roots; abrupt to clear, wavy and broken boundary. Note: contains scattered charcoal flecks; occurs as lenses.
175-180 cm	IIIg	Light gray (10YR 7/1d) medium to coarse sand, gray (10YR 6/1d); single-grained; loose, loose, nonsticky, nonplastic; many, very fine roots; abrupt, broken and irregular boundary. Note: occurs in discontinuous lenses.
180+ cm	IV	Gravels.

Profile Description 9 from the Southern Half of Strawberry Island

Depth	Stratum & Unit	Description
0-5 cm	I	Light brownish gray (10YR 6/2d) fine sandy loam, dark grayish brown (10YR 4/2m); weak, fine granular; soft, friable, slightly sticky, nonplastic; many, very fine roots; no reaction to HCl; clear, smooth boundary. Note: charcoal flecks.
5-12 cm	IIa	Grayish brown (10YR 4.5/2d) sand, very dark grayish brown (10YR 3/2m); single-grained; loose, very friable, nonsticky, nonplastic; many, very fine roots; no reaction to HCl; abrupt, smooth boundary. Note: scattered charcoal flecks.
12-101 cm	IIb	Light brownish gray (10YR 6/2d) fine sand, dark grayish brown (10YR 4/2m); single-grained; loose, very friable, nonsticky, nonplastic; common, very fine roots; slight reaction to HCl; abrupt, smooth boundary. Note: scattered charcoal flecks; a lens of well-sorted sand from 76-84 cm; mottled with krotovinas filled with a sand of higher color value.
101-120 cm	IIIa	Light brownish gray (10YR 6.5/2d) silt loam, very dark grayish brown (10YR 3/2m); massive to weak, adherent, fine subangular blocky; few, fine, distinct, light gray (10YR 7/2d), vertically oriented mottles and few, fine, distinct, yellowish brown (10YR 5/6d) mottles; slightly hard, friable, slightly sticky, low plasticity; common, very fine roots; strong reaction with HCl; abrupt, wavy boundary. Note: fine horizontal laminae mottled with charcoal stains and charcoal flecks.
120-129 cm	IIIb	Light brownish gray (10YR 6/2d) fine sandy loam, dark grayish brown (10YR 3.5/2m); massive to single-grained; soft, very firable, slightly sticky, nonplastic; common, very fine roots; no reaction to HCl; abrupt, smooth boundary. Note: scattered charcoal flecks.
129-143 cm	IIIc	Light brownish gray (10YR 6/2d) silt loam, very dark grayish brown (10YR 3/2m); weak, adherent, fine, angular blocky; few, fine, faint, brown (10YR 5/3d) and few, very fine, prominent, white (10YR 3/1d) vertically oriented mottles; slightly hard to hard, friable, slightly sticky, low plasticity; few, medium roots; strong reaction with HCl; abrupt, irregular boundary. Note: scattered charcoal flecks.
143+ cm	IIId	Light gray (10YR 7/1d) medium sand, grayish brown (10YR 5/2m); single-grained; few, fine, faint, yellowish brown (10YR 5/4d) mottles; loose, loose, nonsticky, nonplastic; few, medium roots; no reaction with HCl. Note: scattered charcoal flecks.
143+ cm		Watertable.

Profile Description 10 from the Southern Half of Strawberry Island

Depth	Stratum & Unit	Description
0-10 cm	I	Light brownish gray (10YR 6/2d) silt, very dark grayish brown (10YR 3/2m); weak, very fine and fine granules; slightly hard, friable, slightly sticky, low plasticity; many very fine and fine roots; no reaction to HCl; clear, smooth boundary. Note: scattered charcoal flecks.
10-32 cm	IIa	Light brownish gray (10YR 6.5/2d) fine sandy loam to fine sand, dark grayish brown (10YR 4/2m); single-grained; few, fine, faint, dark yellowish brown (10YR 4/6m) mottles; soft, very friable, nonsticky, nonplastic; many, very fine roots; slight reaction to HCl; clear, wavy boundary.
32-72 cm	IIb	Light brownish gray (10YR 6.5/2d) fine sand, dark grayish brown (10YR 4/2m); single-grained; few, medium, distinct, dark yellowish brown (10YR 4/6m) mottles; soft, very friable, nonsticky, nonplastic; many, very fine roots; slight reaction to HCl; clear, wavy boundary. Note: contains a discontinuous band of more well-sorted sand from 35-40 cm.
72-100 cm	IIIa	Light brownish gray (10YR 6.5/2d) silt, dark grayish brown (10YR 4/2m); weak, adherent, fine, angular blocky; few, fine, faint, dark yellowish brown (10YR 4/6d) mottles; slightly hard, friable, slightly sticky, low plasticity; many, very fine roots; slight reaction to HCl; clear, smooth boundary. Note: contains a discontinuous band of well-sorted sand which is dark yellowish brown (10YR 4/6d).
100-116+ cm	IIIb	Light gray (10YR 7/2d) sand, grayish brown (10YR 5/2m); single-grained; loose, loose, nonsticky, nonplastic; common, very fine roots; no reaction to HCl.
116+ cm		Watertable.

APPENDIX B

Results of Granulometric Analysis

RESULTS OF GRANULOMETRIC ANALYSIS

Introduction

This analysis was conducted in order to answer questions about the origin of the Stratum III sand units. Previously, Osborne and Crabtree (1961:20) reported that the earliest cultural remains at the site were found within a beach sand. In a preliminary sediment analysis, Mierendorf noted a close similarity between a subsurface sample (from Stratum III as described in this report) and a sample collected from an active dune on the southern tip of Strawberry Island (Mierendorf 1977:106; Figure 27, p. 108). Hassan pointed out that if this unit is aeolian in origin, it may correlate with Hammatt's (1977) Aeolian Sand Units I and II (Hassan 1977:162).

In order to provide more conclusive evidence, sediment samples were collected from Stratum III sands. In addition, samples were collected from the active dunes and beaches of Strawberry Island and Martindale Island. These modern samples are the control group against which the unknown group (Stratum III sands) are compared.

Procedures

All samples were tested for carbonates with a 10 percent solution of HCl. If there was noticeable reaction, the carbonates were removed with a 30 percent solution HCl. These samples were then washed and oven dried.

All samples were tested for organic matter with a 30 percent solution of H_2O_2. If reaction occurred, the organics were removed in a heated 30 percent solution of H_2O_2. These samples were also washed and oven dried.

The samples were then wet-sieved through a standard 4 phi (0.0625 mm) square mesh screen. The sand fraction remaining in the screen was oven dried and screened at 1/4 phi intervals. The silt and clay fractions which passed through the 4 phi screen were analyzed by the hydrometer method.

Statistical Measures

Four statistical measures are computed for each sample. These are the Graphic Mean (M_z), Inclusive Graphic Standard Deviation (σ_I), Inclusive Graphic Skewness (Sk_I), and Graphic Kurtosis (K_G) (Folk 1974).

For ease of statistical manipulation, these statistics use the phi scale proposed by Krumbein (1934). This scale conforms to the Wentworth grade scale with the exception that the particle diameter in millimeters is converted into phi units (ϕ). This conversion follows the formula,

$$\phi = -\log_2 X,$$

where ϕ is the phi value, and
X is the particle diameter in mm.

Stated verbally, the phi value is the power of the diameter in millimeters to the base 2, multiplied by -1. Thus, the coarsest sand, 2 mm in diameter, is 2^1, and upon conversion of the sign, becomes a phi value of -1. The very fine sand/coarse silt boundary occurs at 1/16 mm in diameter, which is 2^{-4}, which becomes 4 phi. Therefore, the larger the positive phi value, the smaller the particle diameter.

The percentage phi values required by the statistical measures are read from graphs of the particle size distribution.

All of the analyses reported have utilized 1/4 phi intervals in accordance the suggestion by Folk: "Screens should be spaced at ½Ø or ¼Ø intervals; a 1Ø spacing is virtually useless, especially if one is trying to detect bimodality or study subtleties of tails" (Folk 1966:75). Curves plotted using 1/4 phi intervals possess many more points. These points are plotted on a graph consisting of a logarithmic scale of cumulative percent along the ordinate, and an arithmetic scale of phi values along the abcissa.

Graphic Mean

This statistic is computed from the formula,

$$M_z = (\phi 16 + \phi 50 + \phi 84)/3.$$

The final statistic value is in phi units and must be converted if metric units are desired. Graphic Mean is a measure of the average size of all sample particles and is subject to the influence of source of supply of detrital particles, effects of transportation, and the environment of deposition.

Inclusive Graphic Standard Deviation

The formula is given by,

$$\sigma_I = \frac{\phi 84 - \phi 16}{4} + \frac{\phi 95 - \phi 5}{6.6} .$$

Again, statistic values are in phi units. This property is commonly called the "sorting" of the sediment, and is a measure of the degree of dispersion around the mean. This formula has the virtue of incorporating 90 percent of the frequency distribution while at the same time deleting the 5 percent at either tail which is not considered reliable (Folk and Ward 1957:13). A value of 0.3 phi means that 66 percent of the sediment sorted between 0.3 phi units above the mean and 0.3 phi units below the mean. As the value approaches 0, the sorting increases (the degree of dispersion decreases).

Inclusive Graphic Skewness

Computation is by,

$$Sk_I = \frac{\phi 84 - \phi 16 + 2\phi 50}{2(\phi 84 - \phi 16)} + \frac{\phi 95 - \phi 5 - 2\phi 50}{2(\phi 95 - \phi 5)} .$$

Values of the statistic are not in phi units since these cancel out. Skewness is a measure of the degree of symmetry of the distribution around the mean. The mathematical limits are -1 to +1. A negative value indicates that the distribution is skewed coarser than the mean; a positive value means the distribution is skewed finer than the mean; a value of 0 means the distribution is symmetrical about the mean.

Kurtosis

This final statistic is computed from the formula,

$$K_G = \frac{\phi 95 - \phi 5}{2.44(\phi 75 - \phi 25)} .$$

As with skewness, values are ratios not accompanied by units. The property being measured is the degree of peakedness or flatness of the distribution curve. A perfectly normal curve is 1 (mesokurtic). A platykurtic curve is flattened and has a value of < 1. A leptokurtic distribution shows above-normal peakedness and has a value > 1.

Use of the Measures

Sedimentologists have claimed that statistical parameters of particle size distributions are sensitive to particular environments of deposition. Folk and Ward (1957) found that beach sands were almost twice as well sorted as bar (riverine) sands of about the same mean diameter. Mason and Folk (1958) were able to discriminate beach, dune, and aeolian deposits by plotting skewness agains kurtosis. Friedman (1961) separated beach and river sands with plots of skewness against sorting; sorting plotted against mean grain size separated dune from riverine sands, but a wide field of overlap existed. These relationships were explored further in Friedman (1962) and (1967).

Reineck and Singh (1973:115) view these attempts as having had only limited success. Pettijohn (1975:52) says:

> . . . despite the voluminous literature and extended efforts made to define grain size, measure it, and calculate the parameters of grain size distribution, the net input toward the solution of geological questions has been disappointingly small relative to the effort expended.

This does not mean; however, the approach is not useful. Visher (1969:1103) and Reineck and Singh (1973:119) state that textural criteria should be con-

sidered only one criterion among others, such as sedimentary structures and position in the sequence, to be used together for determination of depositional environment.

Grain size properties are restricted in another way. Parameter values from one region may not be comparable with those from other regions or even adjacent river basins. This is due to inherited characteristics from the source material (Folk 1966:82; Ahlbrandt 1979:30). In order to control for this variable, samples were collected from modern beach and dune deposits on Strawberry Island and the immediate vicinity. Grain size parameters computed from analysis of these samples were then compared with samples of unknown origin from Stratum III.

Results

Table 1 displays the mean, sorting, skewness, and kurtosis values of twelve modern beach and twelve modern dune samples. Inspection of the average for each column shows that differences exist between the two environments, but due to a wide overlap, the average values are useful only to indicate trends. Thus, there is better sorting (lower σ_I values) among the beach sands; dune sands tend to be slightly more positively skewed and have a smaller mean diameter.

Interpretation

Before discussing the meaning of these statistics, some aspects of sediment deposition in fluvial environments must be understood. Reineck and Singh (1973:230) divide fluvial deposits into three groups: channel, bank, and flood basin deposits.

The gravel and cobble base of Strawberry Island is an example of a channel bar deposit. These can also be composed of fine-grained sands and silts (Kukal 1971:81). Bars are likely to form within a channel wherever the competence of the stream is reduced, such as at a pool or downstream from an obstruction. A point bar is another type of channel deposit. It develops on the convex (inside) bend of a river or at the margin of a migrating channel during floods (Reineck and Singh 1973:231). This distinction between bar types is not always clear:

> There seems to be no well-defined difference in the sequence of point bar deposits and channel bar deposits. This is especially true of the rivers with very fine-grained sediments (Reineck and Singh 1973:244).

Generally, bar sands are good to moderately sorted. Deposition is rapid which can result in entrapment of fine suspended sediment and burial by subsequent units (Folk and Ward 1957:16). This is possible because sediment in suspension "is always available for deposition with the coarser material at the sediment-water interface" (Visher 1969:1077).

Table 1.

SEDIMENT SAMPLE GRAIN SIZE PARAMETERS

Environment	Sample #	Mean (Ø)	Sorting (Ø)	Verbal Limit*	Skewness	Verbal Limit+	Kurtosis	Verbal Limit!
beach	33	2.20	0.39	WS	0.10	NS	1.14	L
beach	34	2.35	0.39	WS	0.02	NS	1.02	M
beach	35	2.15	0.40	WS	0.05	NS	1.10	M
beach	36	2.46	0.43	WS	0.04	NS	1.08	M
beach	37	2.21	0.39	WS	0.10	NS	1.14	L
beach	38	2.26	0.48	WS	0.08	NS	0.94	M
beach	39	2.60	0.51	MWS	0.19	FS	1.22	L
beach	40	2.56	0.47	WS	0.07	NS	1.15	L
beach	41	2.58	0.44	WS	0.13	FS	1.04	M
beach	42	2.16	0.33	WS	0.15	FS	1.04	M
beach	43	2.06	0.29	VWS	0.11	FS	1.07	M
beach	44	2.00	0.44	WS	-0.24	CS	1.50	L
average		2.29	0.41		0.07		1.12	
dune	45	2.60	0.68	MWS	0.23	FS	1.25	L
dune	46	2.52	0.55	MWS	0.10	NS	1.11	M
dune	47	2.40	0.51	MWS	0.22	FS	1.23	L
dune	48	2.93	0.76	MS	0.10	NS	1.04	M
dune	49	3.03	0.83	MS	0.16	FS	1.02	M
dune	50	2.76	0.73	MS	0.07	NS	1.00	M
dune	51	2.78	0.56	MWS	0.15	FS	1.11	M
dune	52	2.65	0.58	MWS	0.18	FS	1.06	M
dune	53	2.81	0.52	MWS	0.08	NS	0.99	M
dune	54	2.75	0.48	WS	0.20	FS	1.05	M
dune	55	2.56	0.71	MS	0.19	FS	1.03	M
dune	56	2.45	0.68	MWS	0.18	FS	1.31	L
average		2.69	0.63		0.15		1.10	

Table 1. (Continued)

Environment	Sample #	Mean (Ø)	Sorting (Ø)	Verbal Limit*	Skewness	Verbal Limit+	Kurtosis	Verbal Limit!
STRATUM III								
unknown	14	2.10	0.49	WS	0.21	FS	1.13	L
unknown	15	2.23	0.55	MWS	0.22	FS	1.36	L
unknown	16	2.18	0.47	WS	0.13	FS	1.04	M
unknown	17	1.71	0.42	WS	0.31	SFS	1.18	L
unknown	18	2.41	0.64	MWS	0.28	FS	1.43	L
unknown	19	2.28	0.63	MWS	0.30	FS	1.25	L
unknown	22	1.80	0.42	WS	0.27	FS	0.03	VP
unknown	23	2.36	0.76	MS	0.31	SFS	1.12	L
unknown	24	2.33	0.69	MWS	0.42	SFS	1.33	L
unknown	25	2.41	0.78	MS	0.28	FS	0.97	M
unknown	26	2.53	0.86	MS	0.12	FS	1.01	M
unknown	27	3.65	1.03	PS	0.24	FS	1.21	L
unknown	28	3.55	1.09	PS	0.29	FS	1.40	L
flood basin	29	4.51	1.64	PS	0.37	SFS	1.34	L
Stratum II	30	3.86	1.82	PS	0.46	SFS	1.88	VL
flood basin	31	5.68	1.96	PS	0.38	SFS	1.22	L
Stratum II	32	3.23	1.17	PS	0.26	FS	1.16	L

* WS = well sorted, VWS = very well sorted, MS = moderately sorted, MWS = moderately well sorted; PS = poorly sorted

+ NS = nearly symmetrical, FS = fine skewed, SFS = strongly fine skewed, CS = coarse skewed

! M = mesokurtic, L = leptokurtic, VP = very platykurtic, VL = very leptokurtic

Bank sediments are those deposited on the river bank. One type, natural levees, form when flood waters spill over the bank, resulting in rapid deposition of suspended sediment. These deposits are moderately to poorly sorted, and tend to be finer than channel deposits.

Flood basin deposits, the third type, form when flood waters cover the lowest portion of a river flood plain. Here, the finest-grained suspended sediment drop out slowly. Flood basin deposits are high in silt and clay, and are poorly sorted.

Kukal (1971) and Reineck and Singh (1973) note that bank deposits can easily be mistaken for channel or flood basin deposits, so that in all cases their distinction may not be clear. These depositional types may grade into each other.

In beach deposits, wave energy is considered a controlling factor in determining the properties of the sediment. Specifically, waves breaking against a shore constantly rake grains back and forth in a swash zone, surf zone, and breaker zone (Reineck and Singh 1973:286). This action results in winnowing of the fine suspension load. In the modern samples analyzed for this study, with one exception, all beach samples are consistently better sorted than the dune sands.

Along a river the beach zone, if it exists at all, fluctuates with variations in the river level. Thus, at low river levels winnowing may take place where the shoreline contacts a channel or point bar deposit; at higher levels the shoreline may break against bank deposits. Whatever the river level, factors controlling wave action at a shoreline include wind direction and strength, current direction and strength, depth of water, and slope of the channel bottom. All these factors are subject to abrupt changes.

At Strawberry Island the natural riverine environment has been altered by formation of the McNary reservoir. Presently, the river level is stabilized (within a five foot fluctuation in elevation) at an elevation that in pre-reservoir times would have been associated with winter or spring floods. This has resulted in erosion of bank deposits and their subsequent reworking by wave action into beach deposits. It is from these beaches that the modern samples have been taken.

Prior to formation of McNary reservoir, it is doubtful that the free-flowing Snake River could have maintained stable shorelines comparable to those that exist today. Therefore, any pre-reservoir beach deposits would probably be localized deposits resulting from ephemeral wave action subject to rapidly changing conditions.

The results of the granulometric analysis can now be interpreted. The well-sorted character of the modern beach deposits has been attributed to the winnowing away of fine sediments by wave action. However, the positive skewness of these deposits does not follow the trend observed for a large number of beach sands from many locations as reported by Friedman (1961). Almost all beach sands are negatively skewed as a result of the removal of the fine tail by winnowing (Friedman 1961:521). The occurrence of positively skewed beach sands can be explained as the result of "inheritance" of a fine tail by channel deposits and the fact that the sands have

not yet achieved equilibrium with the beach environment (Friedman 1961:516; Mason and Folk 1958:223-224). It is probable that analogous processes are operating at Strawberry Island. Here the winnowing away of fines is constantly working against the addition of fines from erosion of bank sediments and silt deposition in the lacustrine-like reservoir environment. In fact, during collection of the modern samples, it was difficult to locate a beach which did not possess visible micro-laminae of silt between sand laminae. Although an attempt was made to control for this by collecting samples about one centimeter thick, parallel with the depositional interfaces, mixing of micro-laminae was unavoidable. It was not expected under these circumstances, that the beach samples would be well sorted. The actual sorting values of the sand laminae should be lower than the measured values.

The trend toward greater positive skewing and smaller mean grain size among the dune samples agrees with results from other regions. Wind as a transporting medium has a lower competency than water (Friedman 1961: 520). Thus when wind reworked riverine sediments, the coarser tail is lagged behind. The result is usually positive skewness, poorer sorting, and decrease in mean grain size for the wind deposited sediments (Mason and Folk 1958; Folk and Ward 1957).

Reineck and Singh point out the role of aeolian sediments in fluvial deposits:

> The active sedimentation in fluvial environments takes place only during high floods, ie, only a couple of days or weeks in a year. Most of the time fluvial sediments are exposed to the activity of wind . . . in dry climates or in areas having long dry periods, upper point bar deposits, levee and crevasse splay deposits, and flood basin deposits are subject to wind activity (Reineck and Singh 1978:261-262).

Wind activity is a locally active process at the Miller Site today and must have been so in the past. Some aeolian reworking of subsurface deposits is to be expected. This is an important consideration because as wind removes fine particles, it acts as a sorting medium on the lagged riverine sands (Reineck and Singh 1973:210).

Table 1 shows the grain size parameters of the Stratum III samples. Considered as a group, mean and kurtosis values differ insignificantly from modern beach and dune samples. Sorting is poorer and skewness seems to be generally more positive than the modern samples. However, the range of values for each statistic are broad.

For purposes of comparison two flood basin units from Stratum III and two culturally mixed units from Stratum II were granulometrically analyzed. The results are recorded in Table 1. These indicate the magnitude of parameter differences associated with other depositional environments.

In order to meaningfully compare the modern samples with those of undetermined origin, scattergrams have been used. Figure 1 is a scattergram of the 24 modern samples plotted against sorting and skewness values. These parameters were chosen because they separate local dune from beach samples better than any other parameters. Two distinct clusters having a

small area of overlap are visible. Figure 2 shows the distribution of thirteen Stratum III samples relative to the modern sample clusters. Clearly only one of the Stratum III samples falls within the "beach" portion of the diagram; only one of the Stratum III samples falls within the "dune" portion of the diagram. It appears that some other processes must be contributing to the grain size parameters of the Stratum III sands.

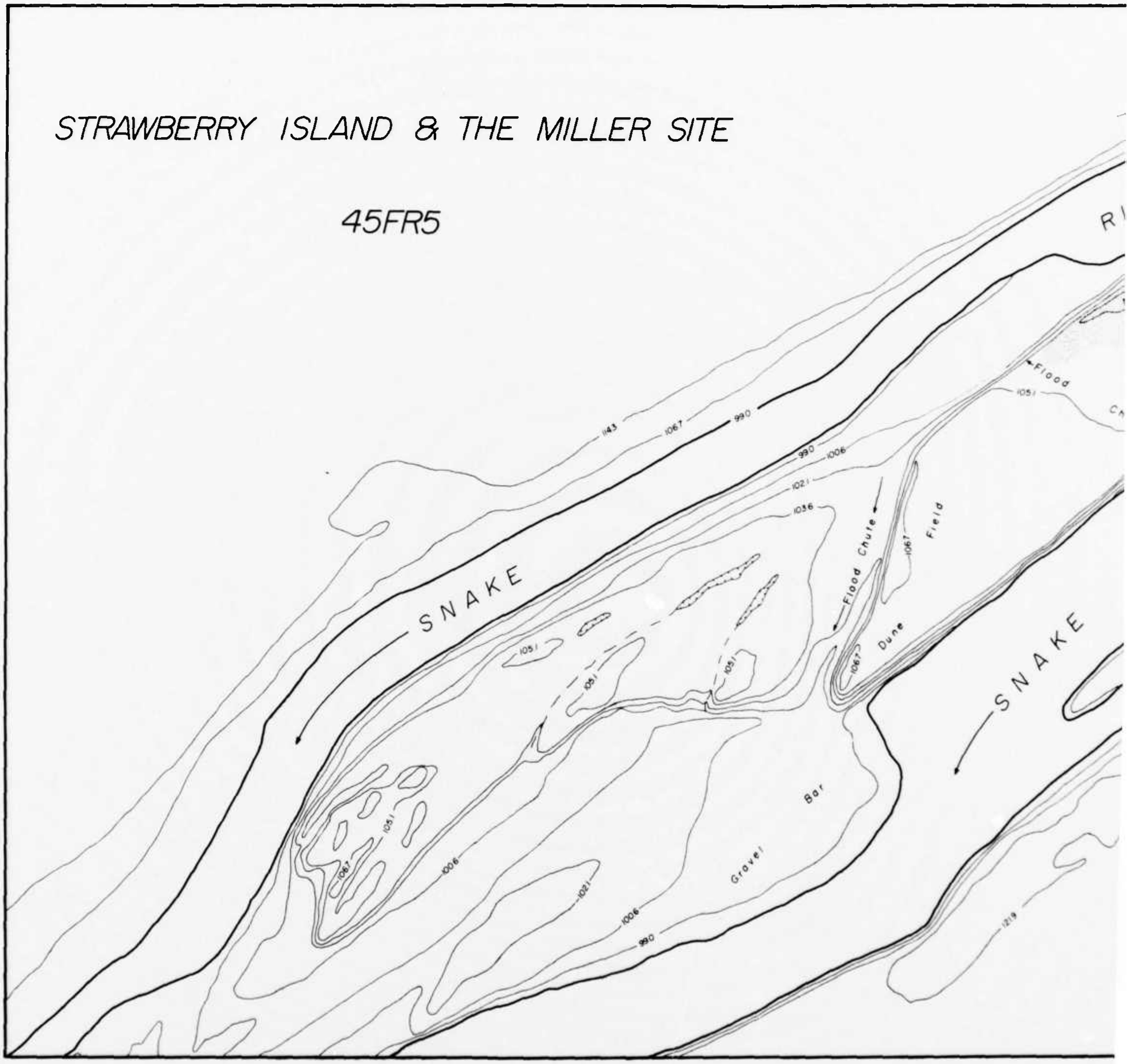
Used in conjunction with information about the bedform and sedimentary structures of Stratum III units, the grain size parameters are more enlightening. Stratum III generally consists of alternating beds of sands and silts. These are tabular in some cases and lenticular in others. Reineck and Singh (1973:233) note that these bedforms tend to occur with point bar deposits. Except in one ambiguous case, cross-bedding is nonexistent in Stratum III sands; most lack any macroscopically visible sedimentary structures. In contrast, modern beach deposits show planer cross-bedded laminae and modern dune deposits show foreset laminae. Also, the Stratum III sand units are found uniformly across the island they are not localized as are modern dunes. Considering all the above evidence, the most plausible inference is that the Stratum III sands were deposited in moving water. Deposition was probably controlled by fluctuations in discharge working upon local variations in island topography, morphology, and vegetation to produce conditions responsible for point bar-like and channel bar-like deposits. The tendency of such riverine deposits for poorer sorting relative to beach and dune sands and the positive skewness of riverine samples is consistent with results reported by others (Reineck and Singh 1973; Friedman 1961). Finally, aeolian reworking of these deposits between depositional episodes cannot be discounted.

Conclusion

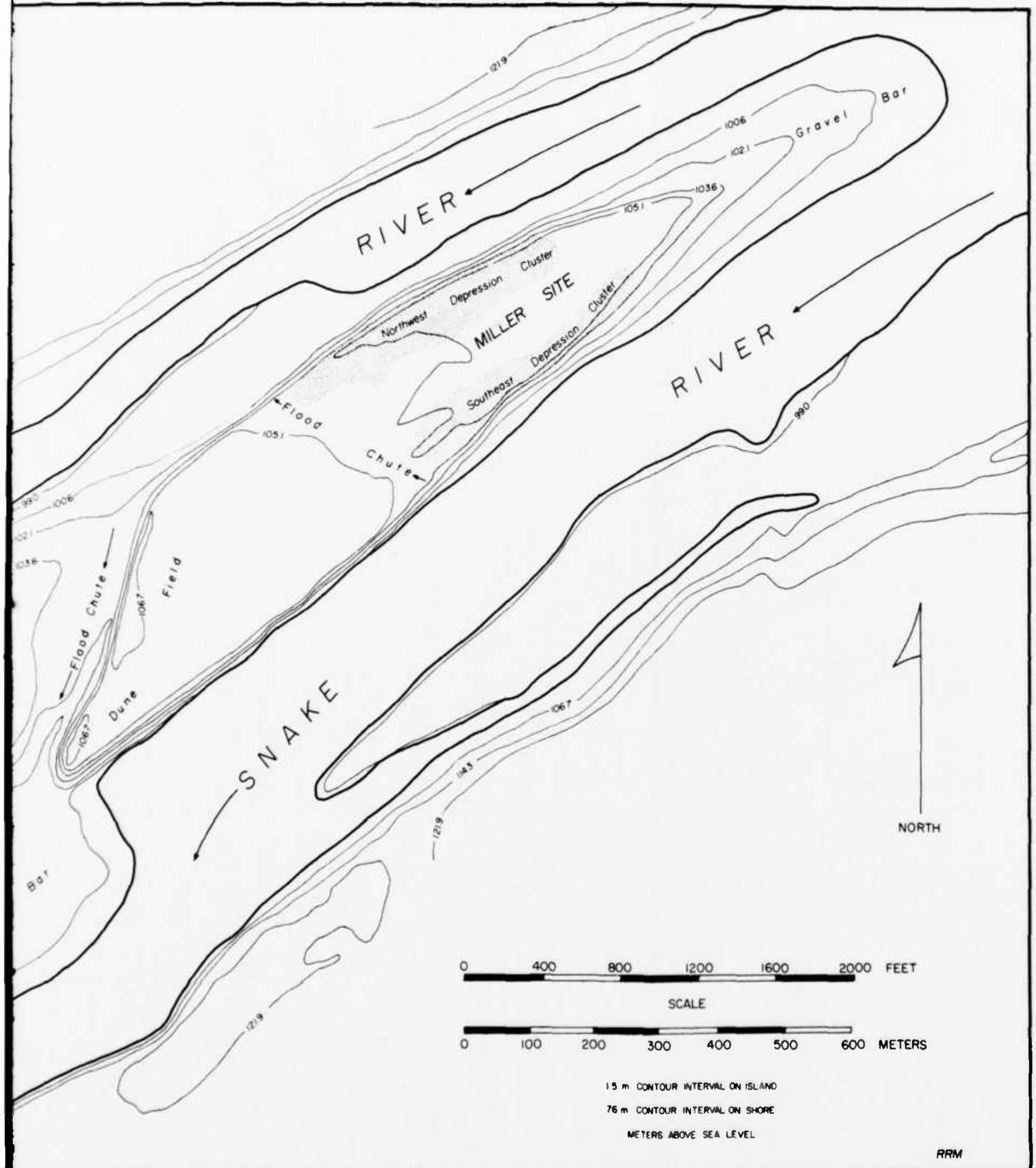
Grain size parameters of sorting and skewness are useful in distinguishing modern beach and dune deposits. Comparison with the Stratum III sands indicates that they are similar in grain size properties to neither of these depositional environments. Grain size parameters in conjunction with bedforms and sedimentary structures are used to infer that Stratum III sands are probably river bar deposits. No modern bar deposits are available for sampling. Topography and vegetation of the initial gravel bar along with seasonal fluctuations in river discharge probably resulted in conditions suitable for sedimentation in point bar-like and channel bar-like depositional environments.

APPENDIX C

Locational Maps and Profile Diagrams

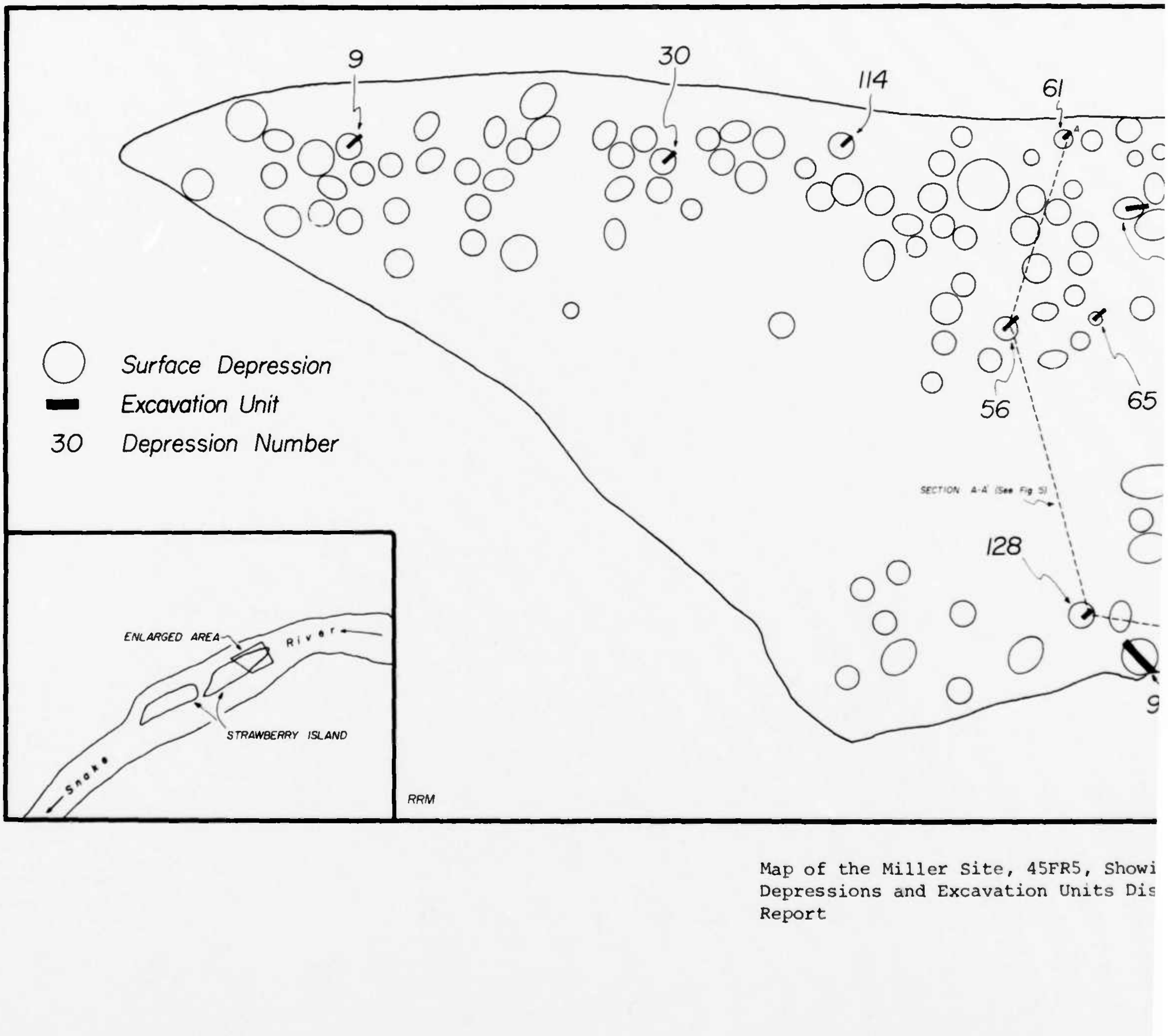


Contour Map of Strawberry Island Prior to the (
of McNary Reservoir (adapted by R. R. Mierendo
U.S. Army Corps of Engineers Survey Map, 1937,
Oregon)

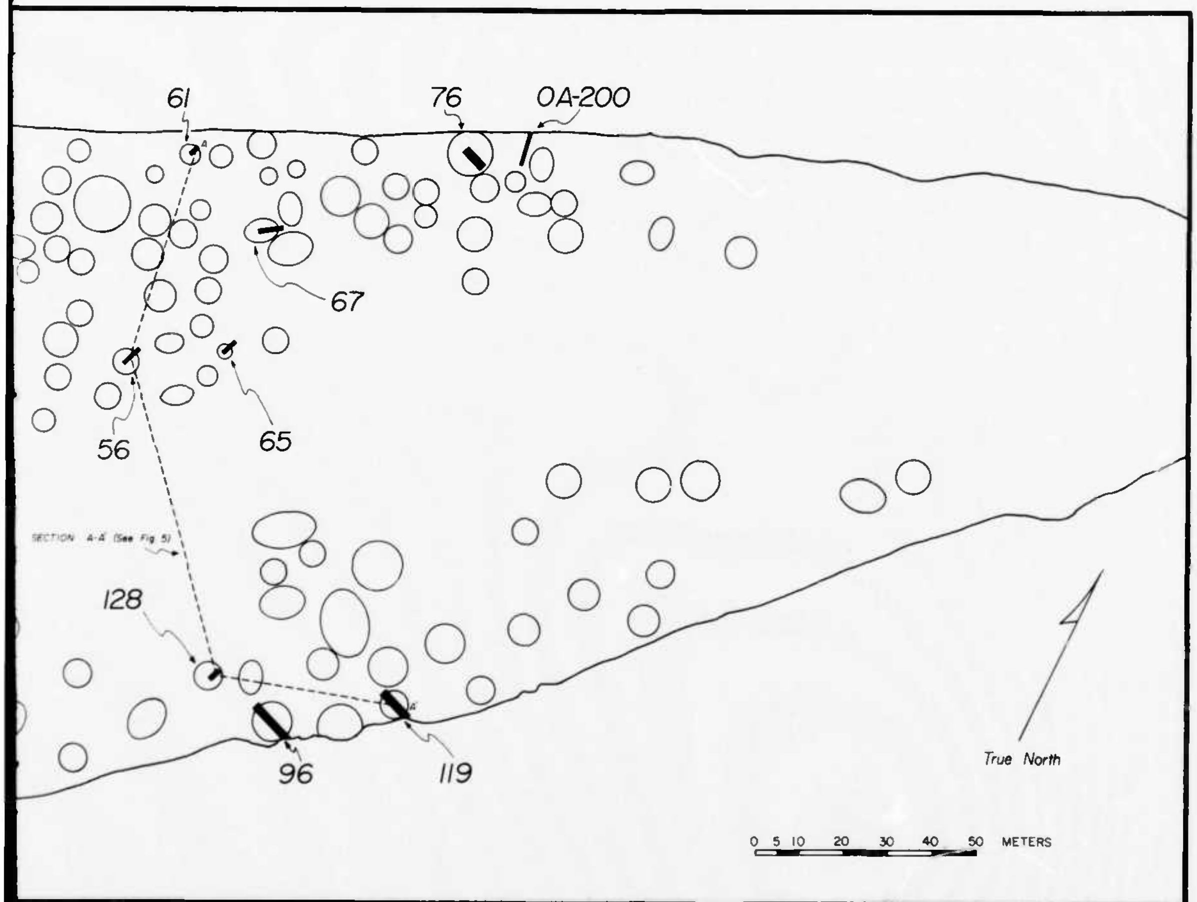


rawberry Island Prior to the Creation
ir (adapted by R. R. Mierendorf from
f Engineers Survey Map, 1937, Portland,

2

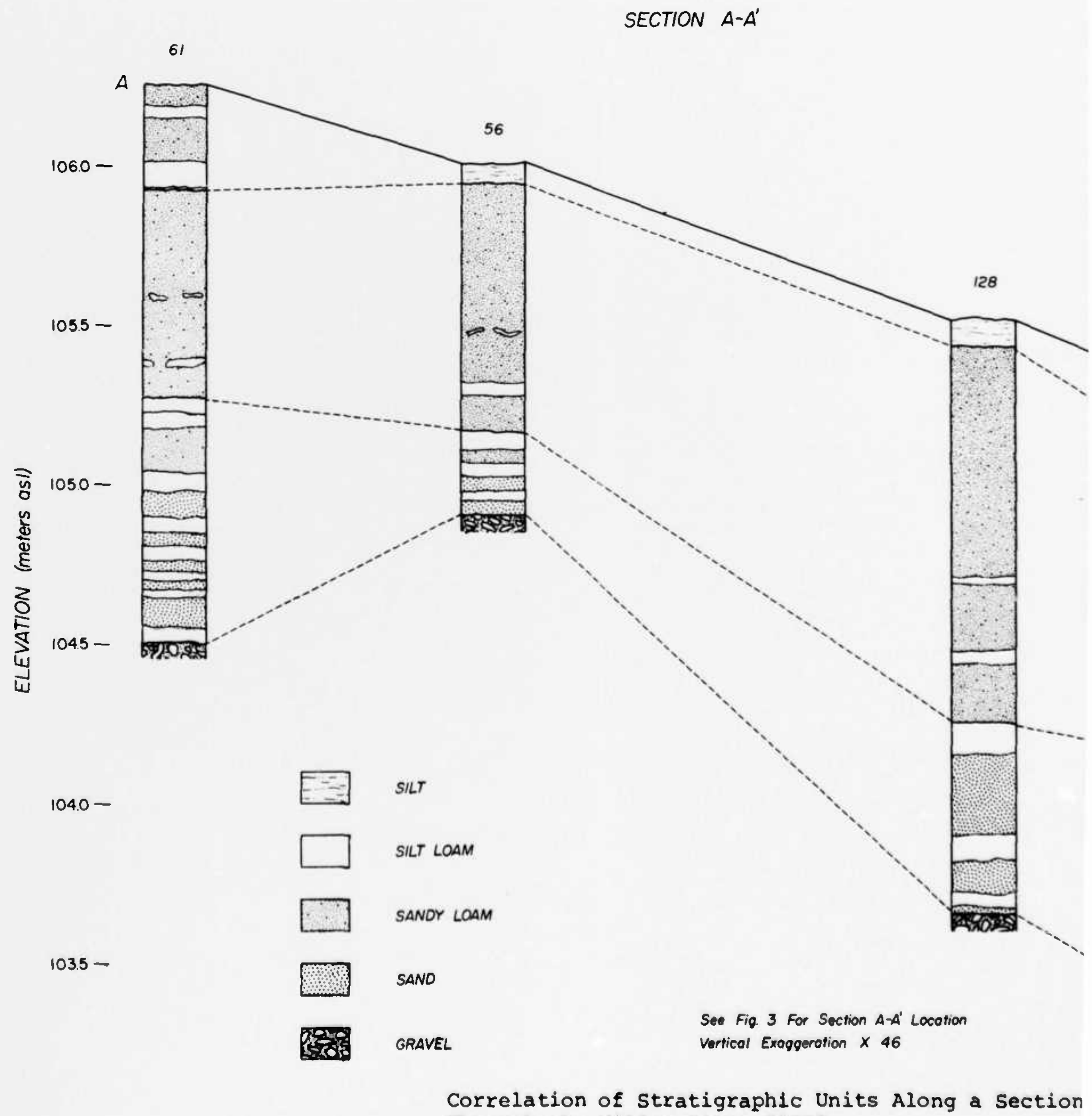


Map of the Miller Site, 45FR5, Showi
Depressions and Excavation Units Dis
Report



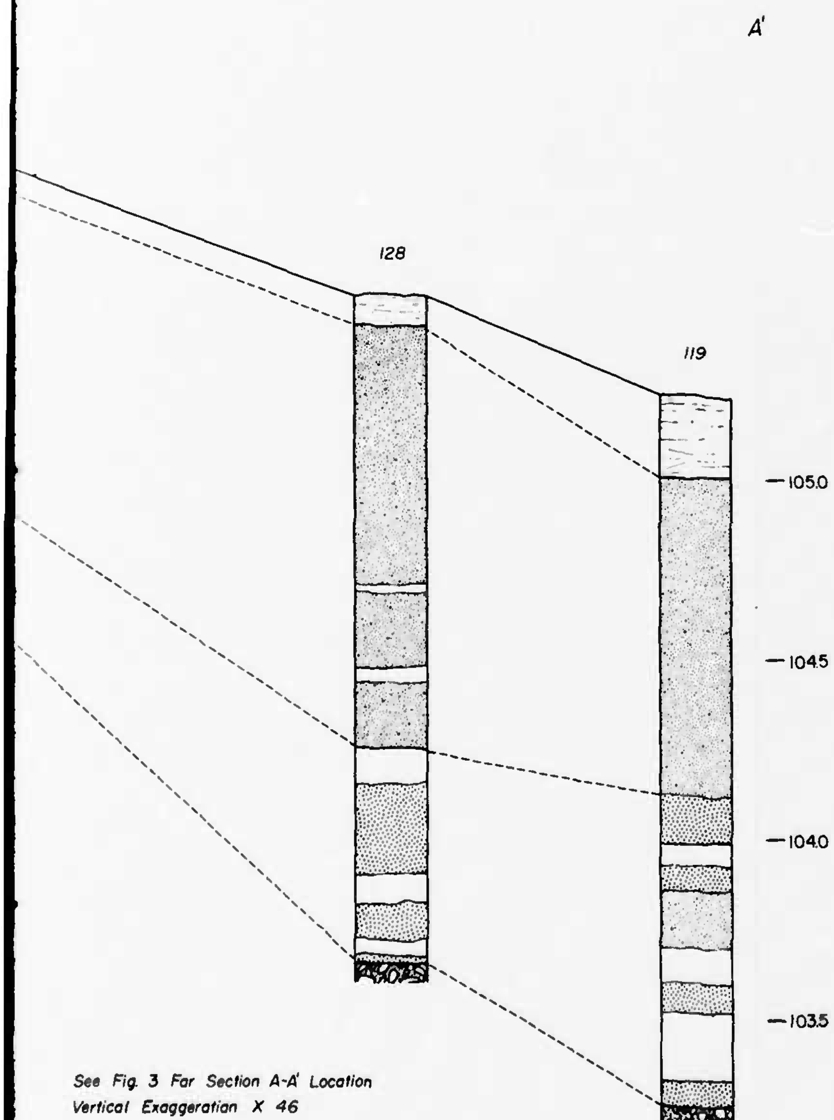
ller Site, 45FR5, Showing the Recorded
d Excavation Units Discussed in this

2



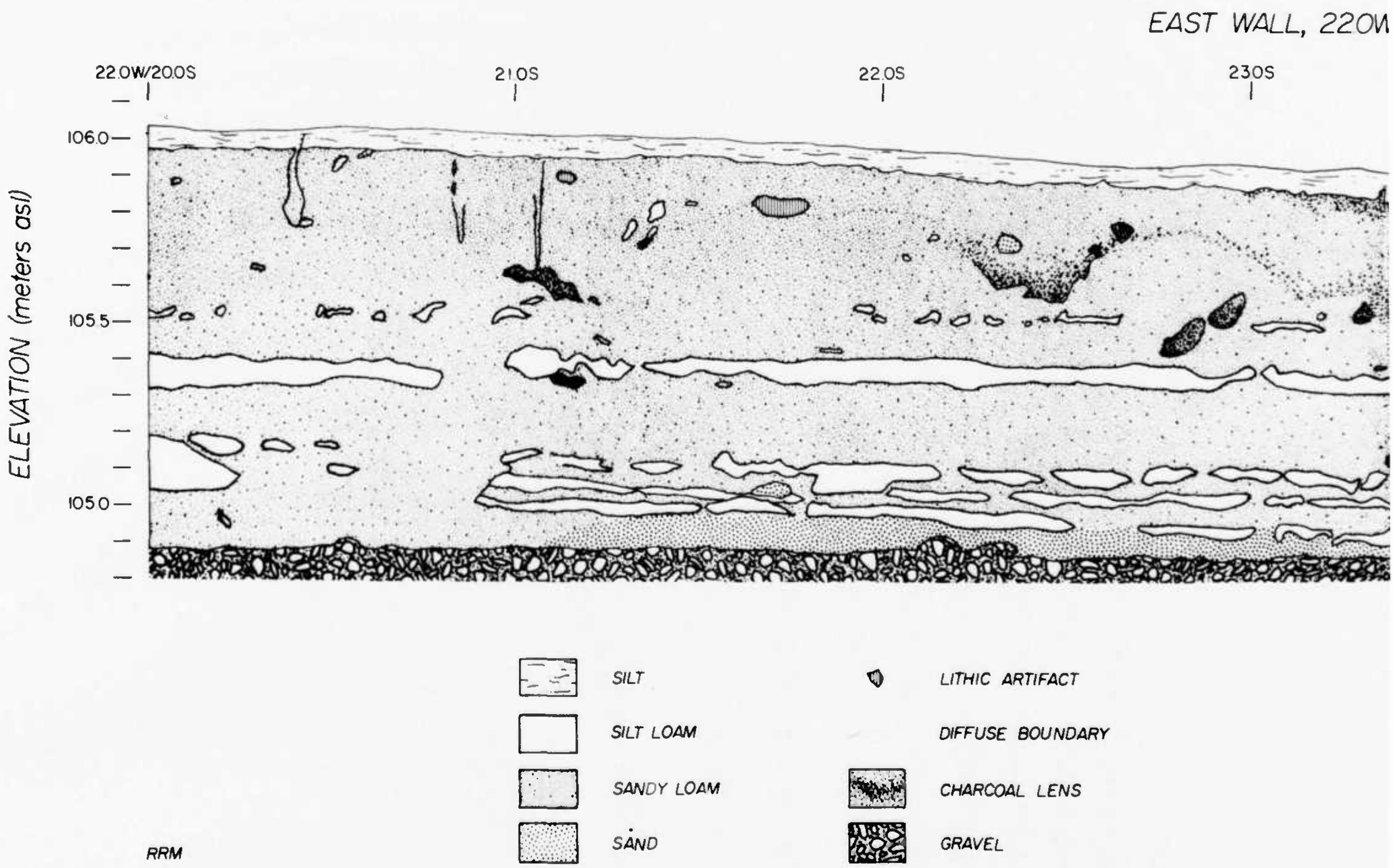
Correlation of Stratigraphic Units Along a Section
Through the Miller Site, 45FR5

CTION A-A'



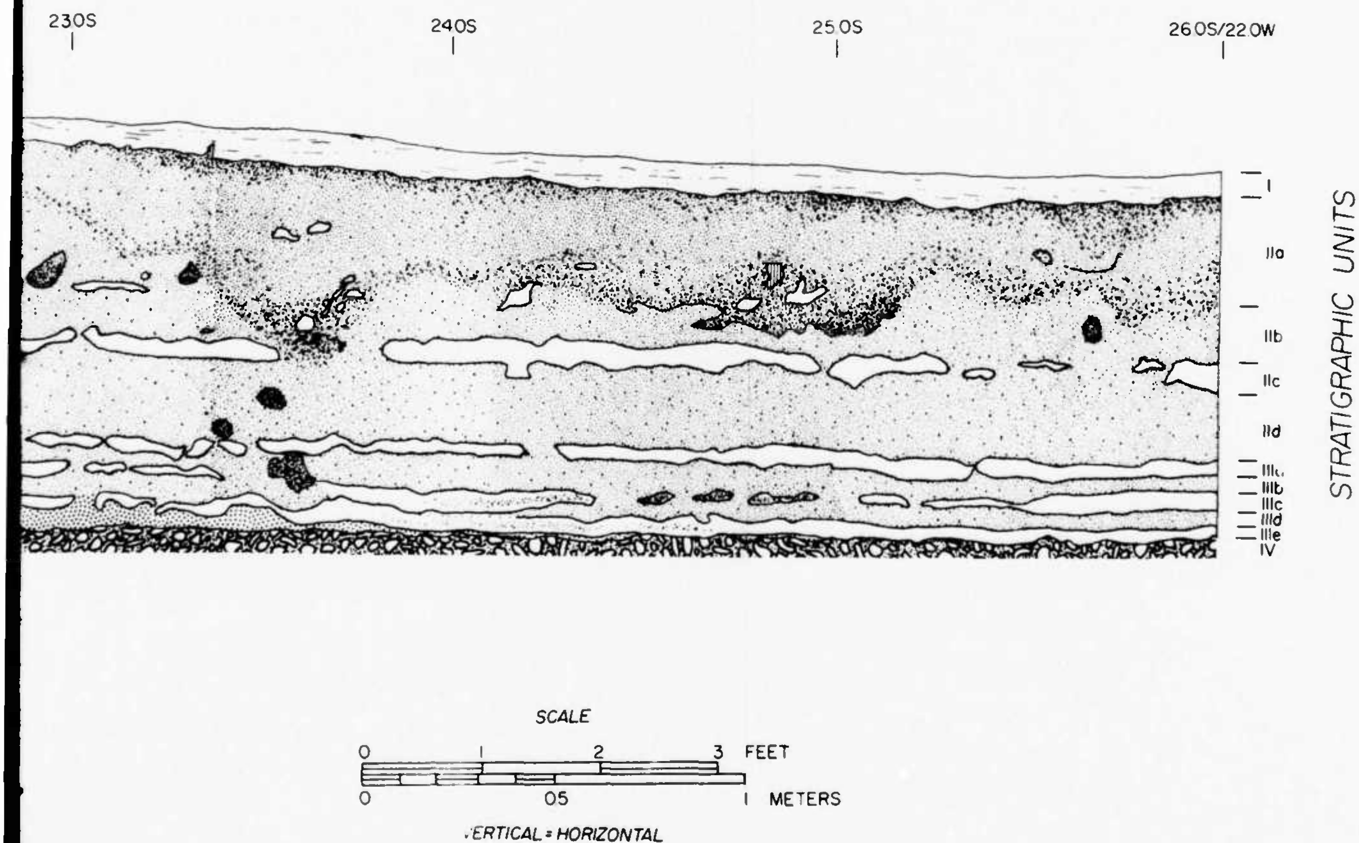
See Fig. 3 For Section A-A' Location
Vertical Exaggeration X 46

tratigraphic Units Along a Section
er Site, 45FR5

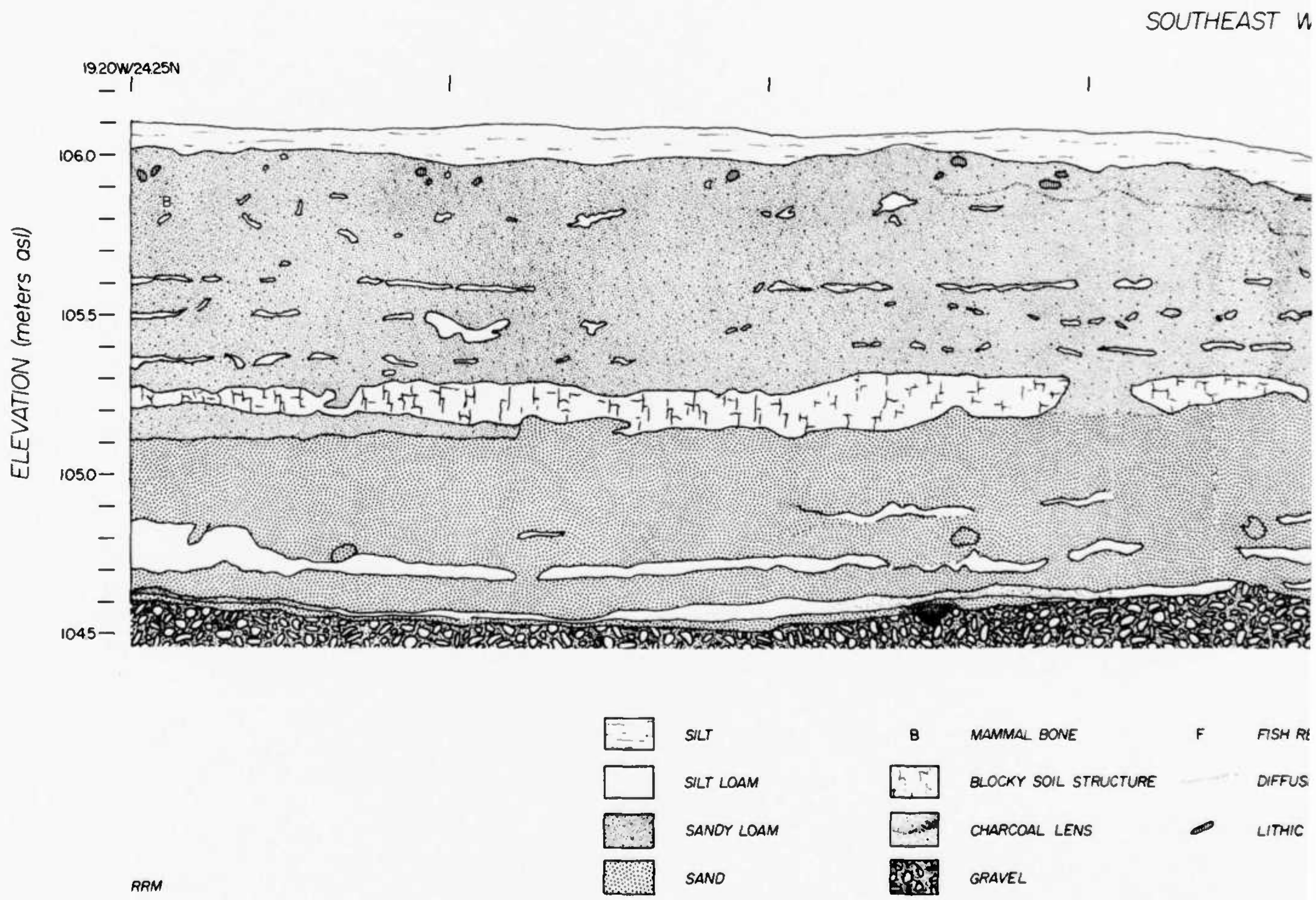


Profile Diagram of the East Wall
Through Depression 56 with No Pi

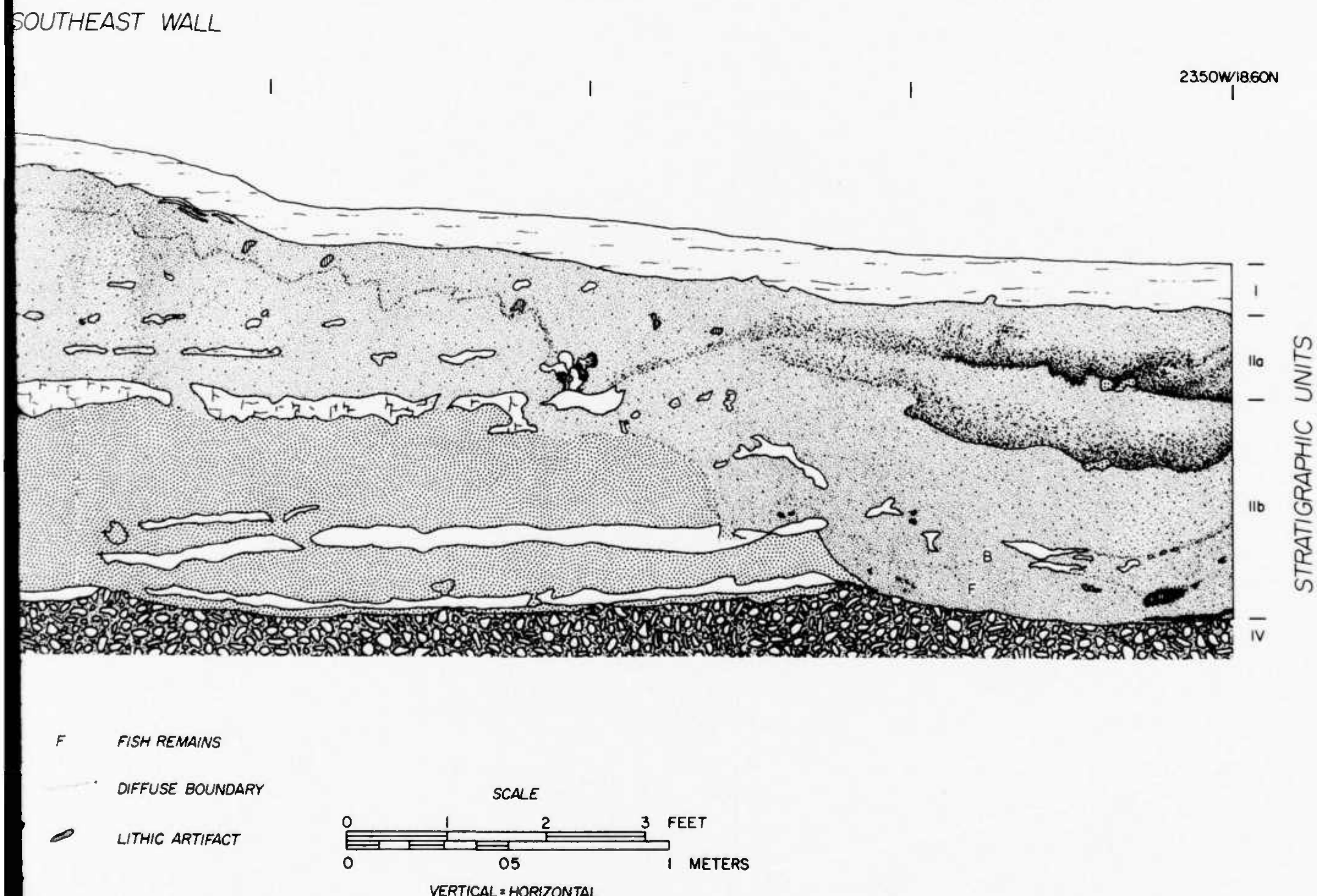
T WALL, 220W



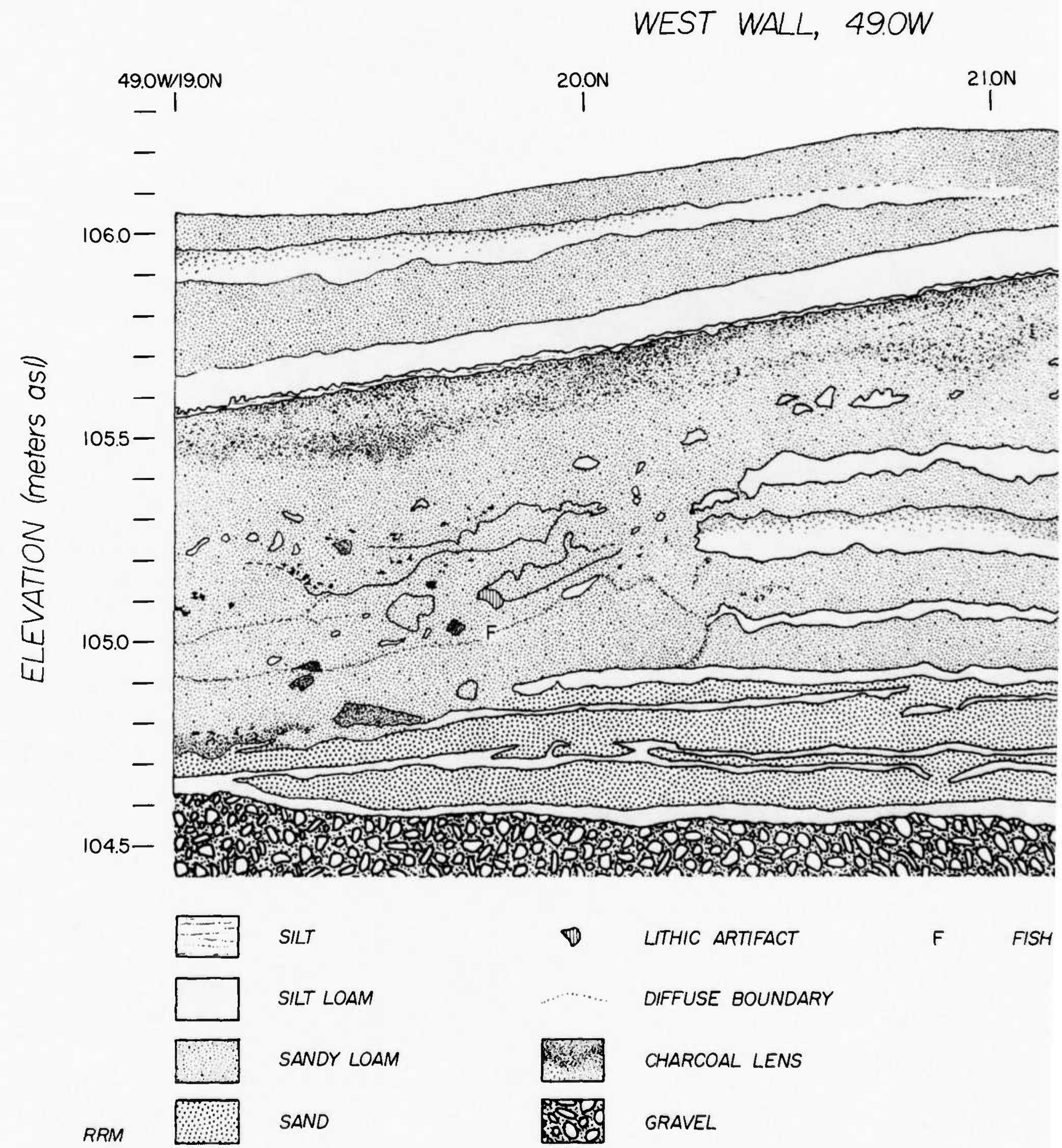
the East Wall of the Test Trench
56 with No Pit Feature Visible



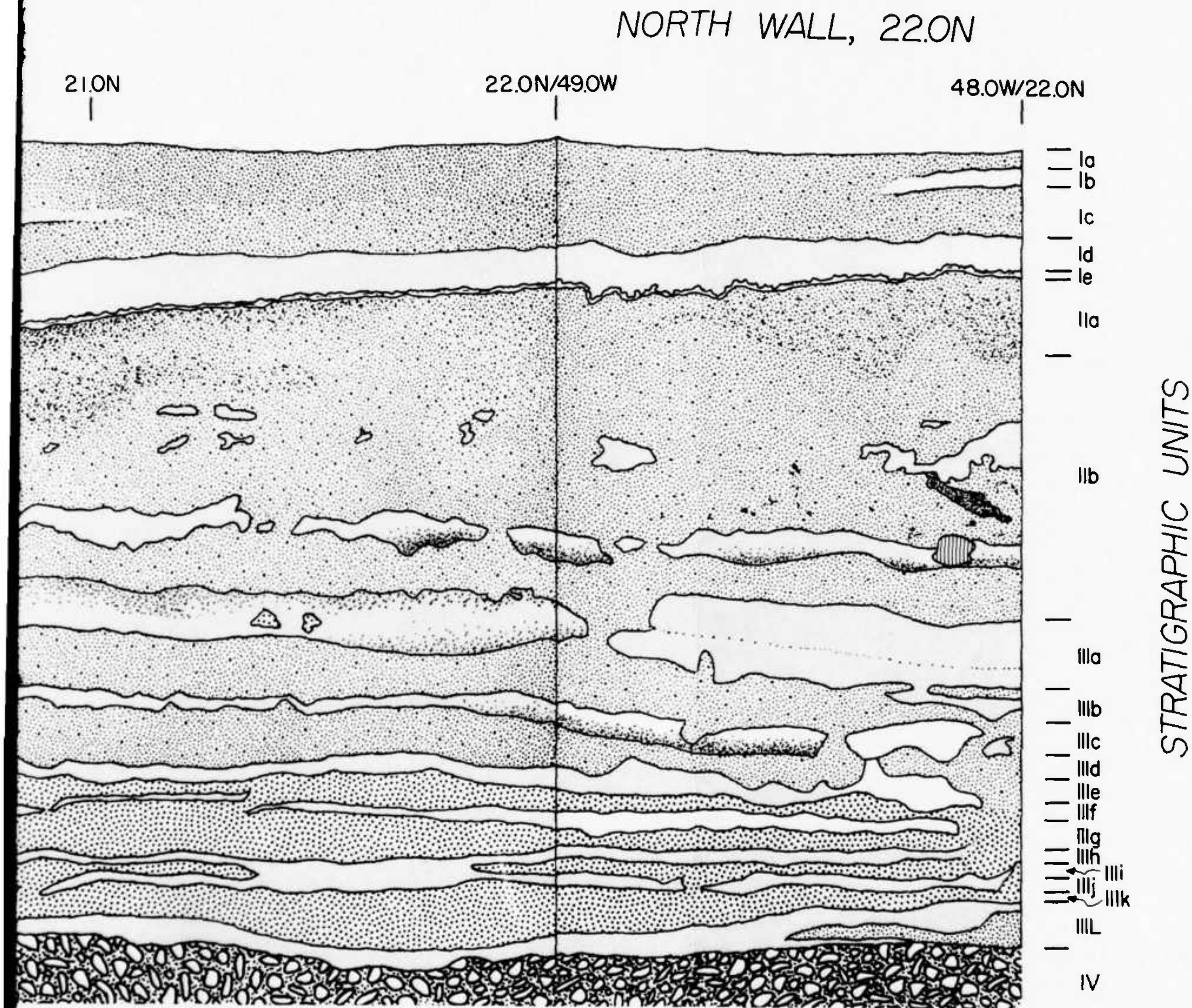
Profile Diagram of the Sou
Trench Through Depression
a Steep, Abrupt Walled Pit



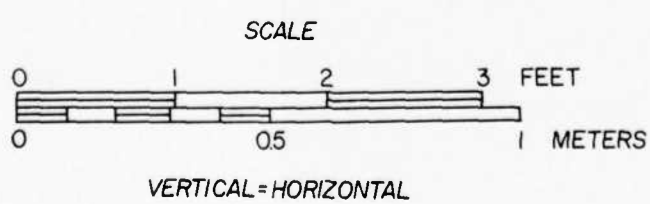
of the Southeast Wall of the Test
Depression 67 Showing One Side of
Walled Pit Feature



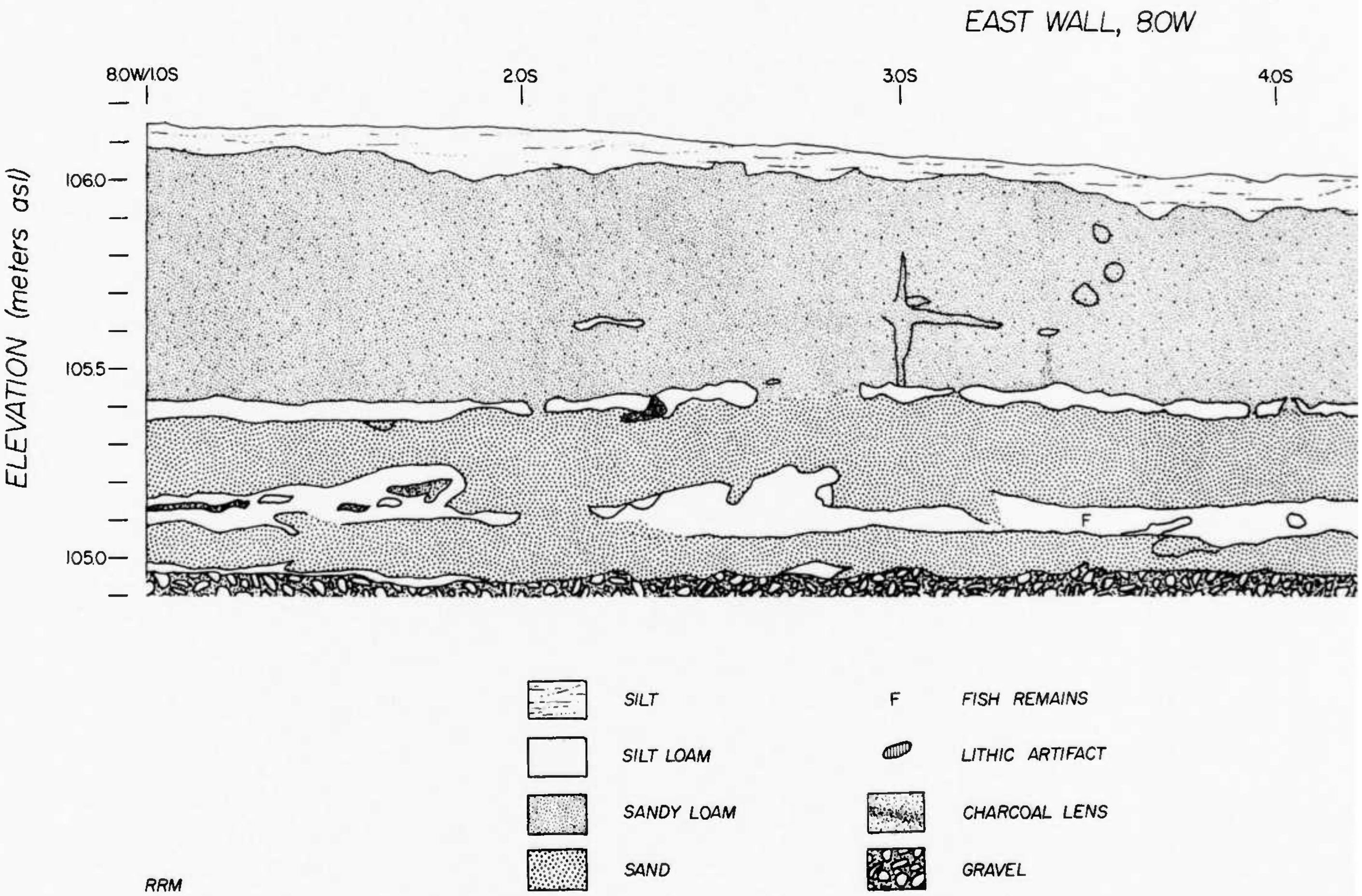
Profile Diagram of the We
Test Trench Through Depre
of a Steep, Abrupt Walled



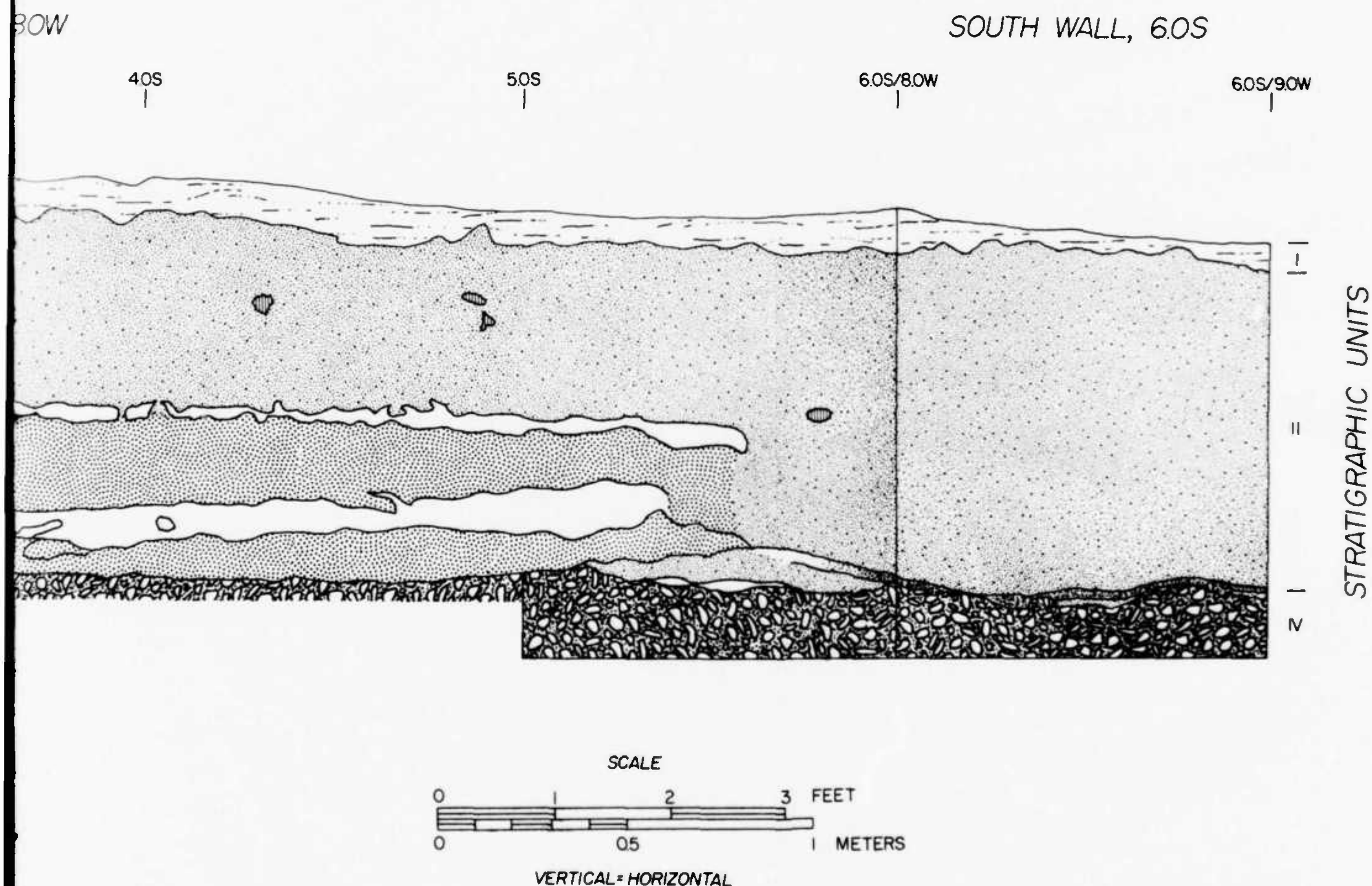
F FISH REMAINS



n of the West and North Walls of the
rough Depression 61 Showing One Side
rupt Walled Pit Feature

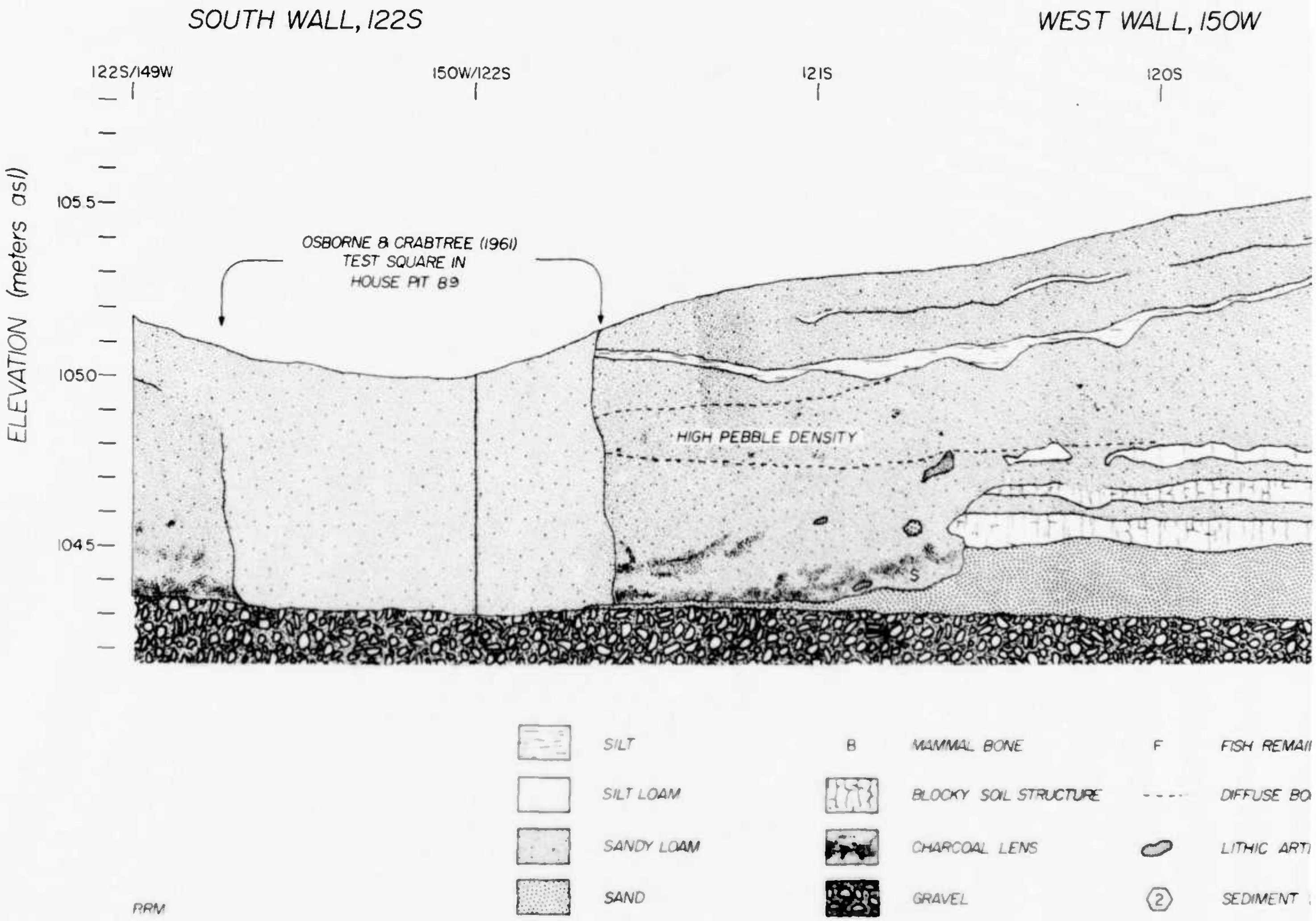


Profile Diagram of the East
Test Trench Through Depress
of a Steep, Abrupt Walled P

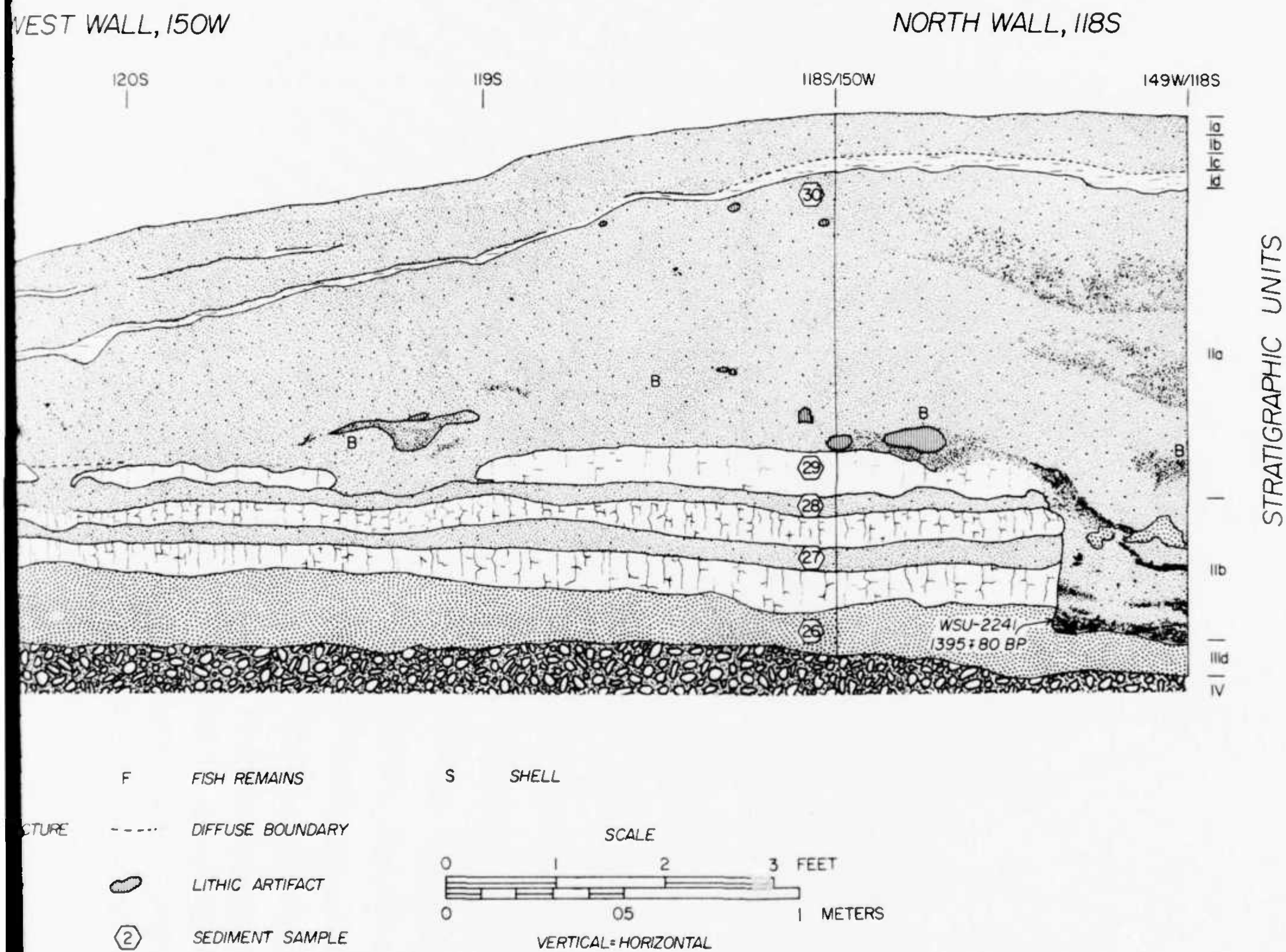


ram of the East and South Walls of the
Through Depression 65 Showing One Side
Abrupt Walled Pit Feature

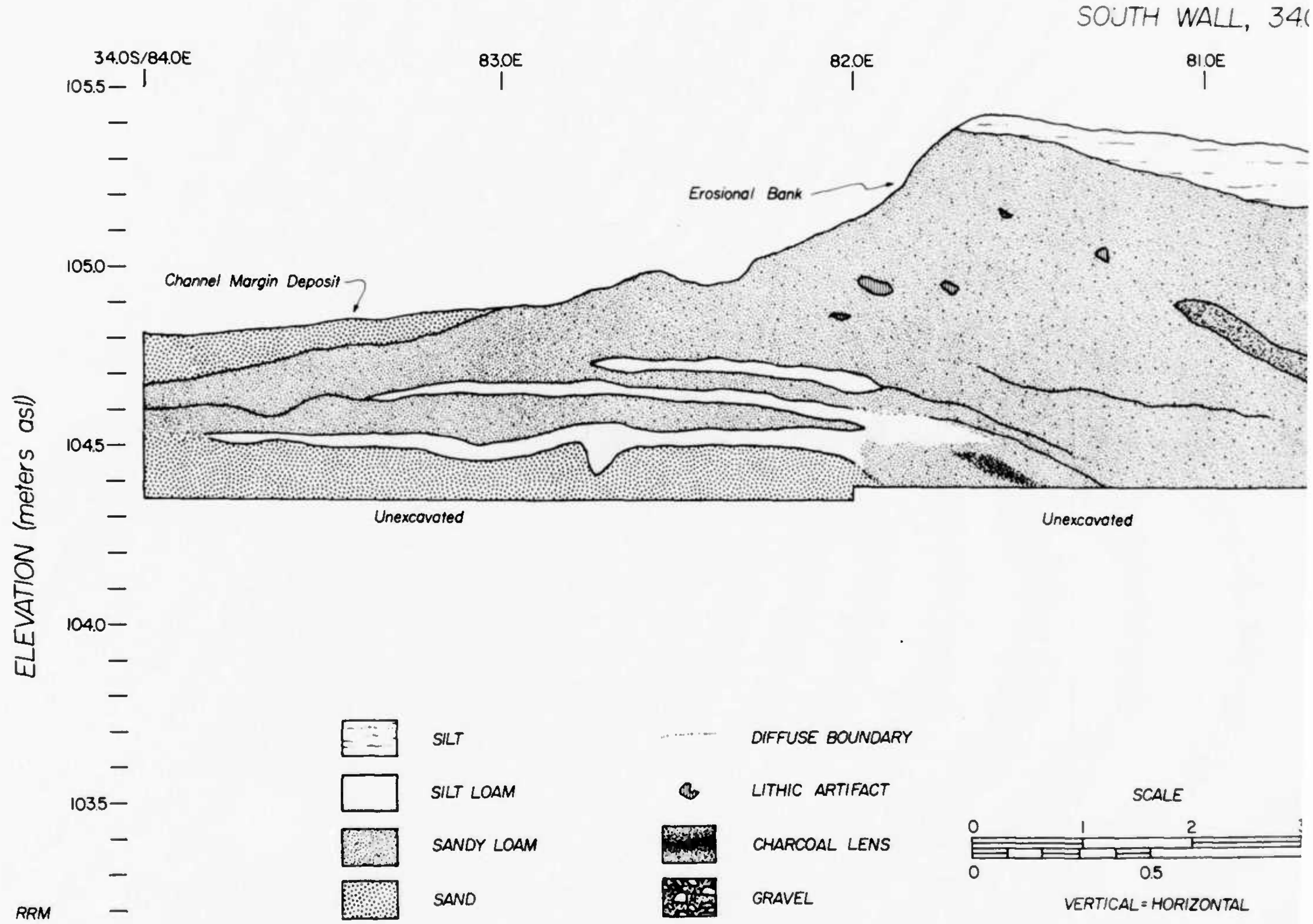
2



Profile Diagram of the South, West
of the Test Trench Through Depress
Portions of Two Steep, Abrupt Wall

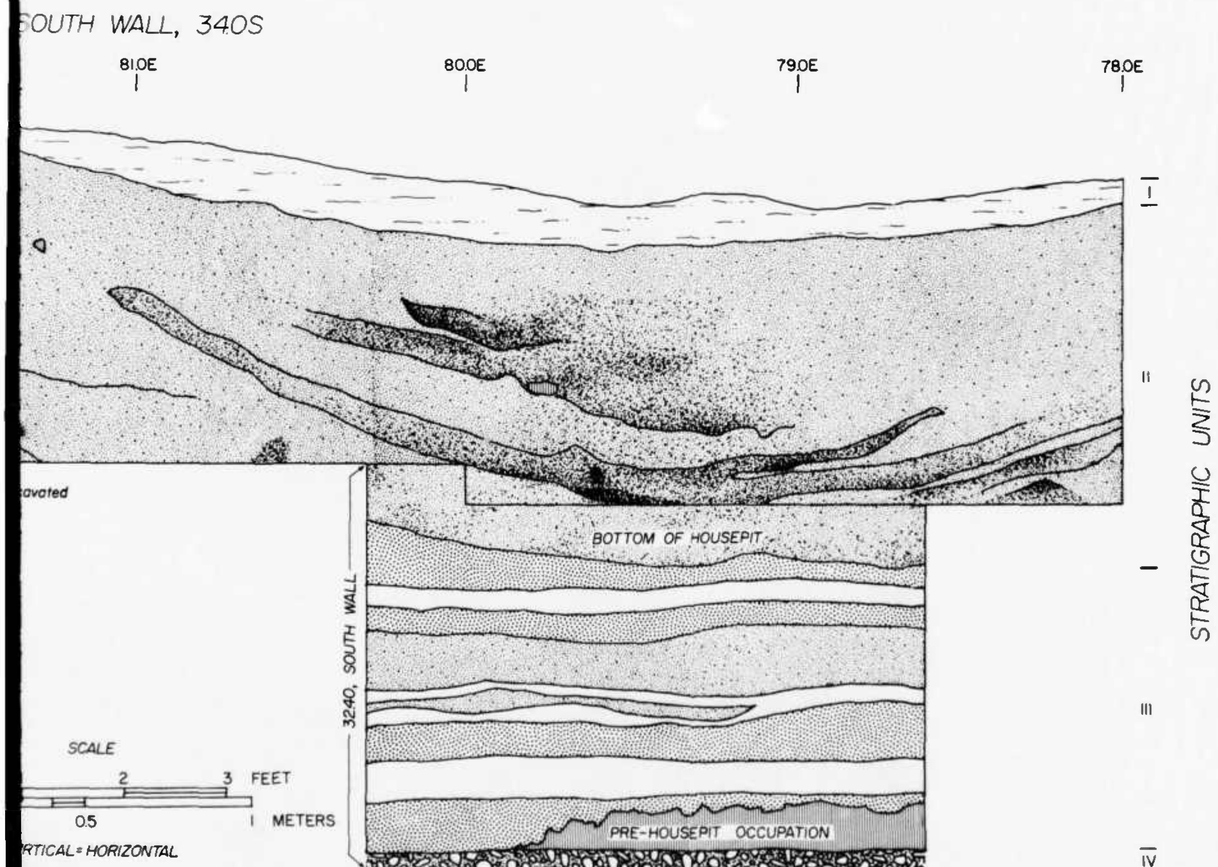


m of the South, West, and North Walls
ench Through Depression 9 Showing
o Steep, Abrupt Walled Pit Features



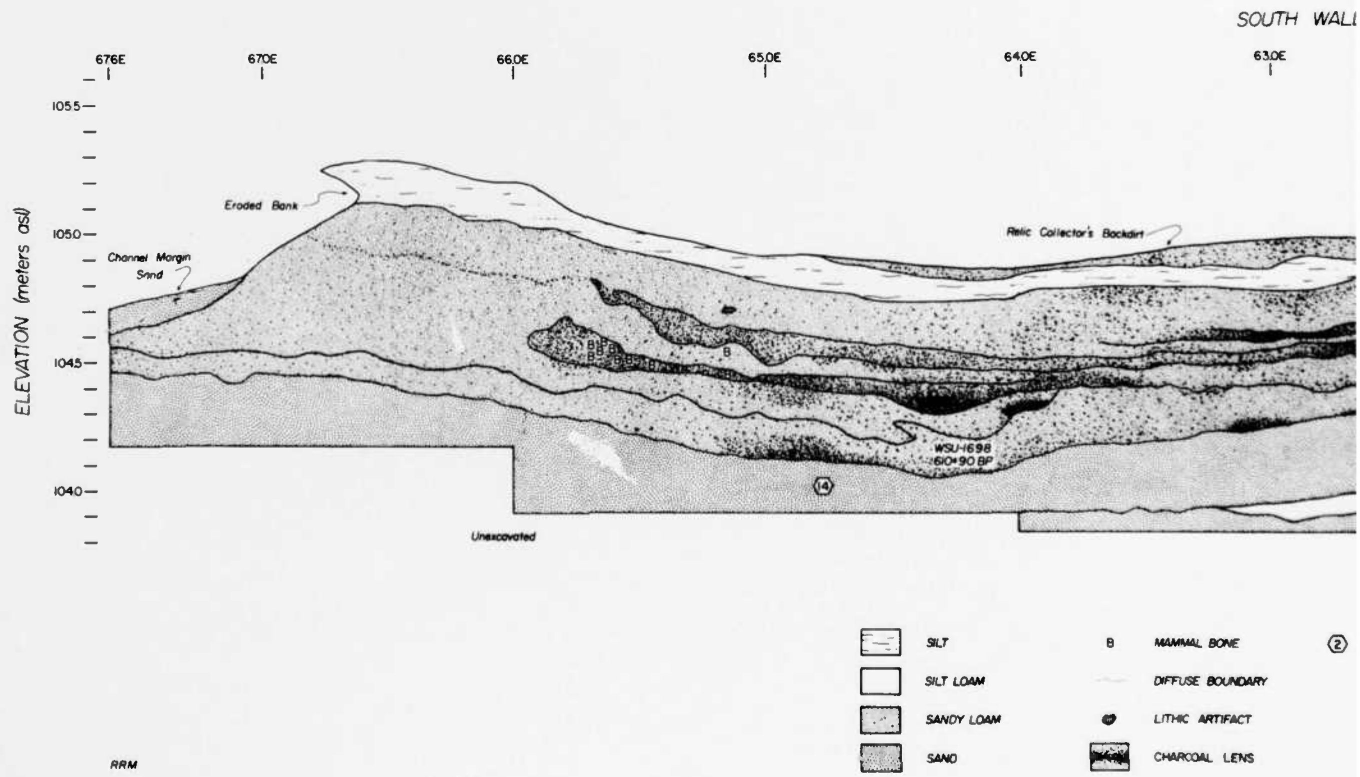
Profile Diagram of the South W
Through Depression 119 and the
Component Showing One Side of
Gradually Sloping Wall

2

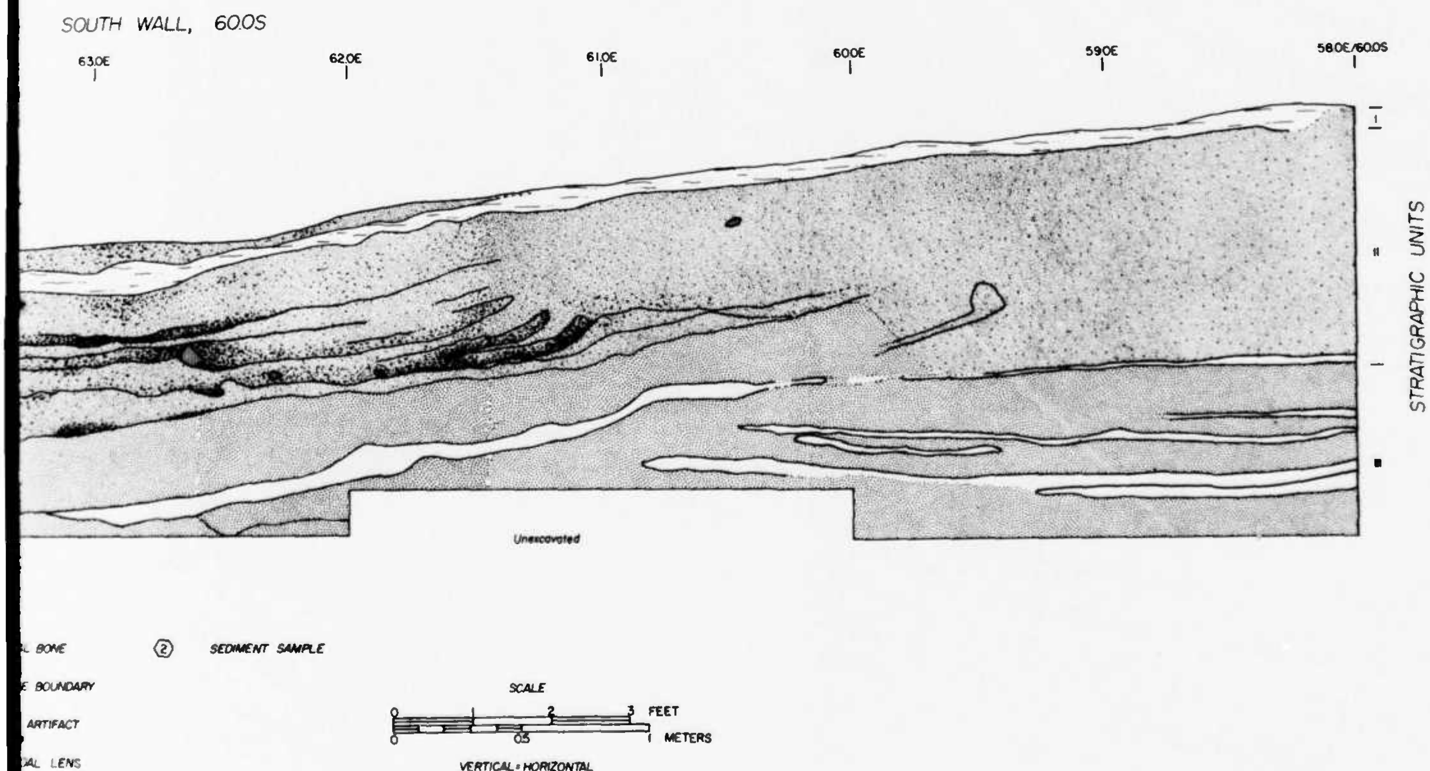


am of the South Wall of the Test Trench
ssion 119 and the Underlying Cultural
wing One Side of a Pit Feature with a
ping Wall

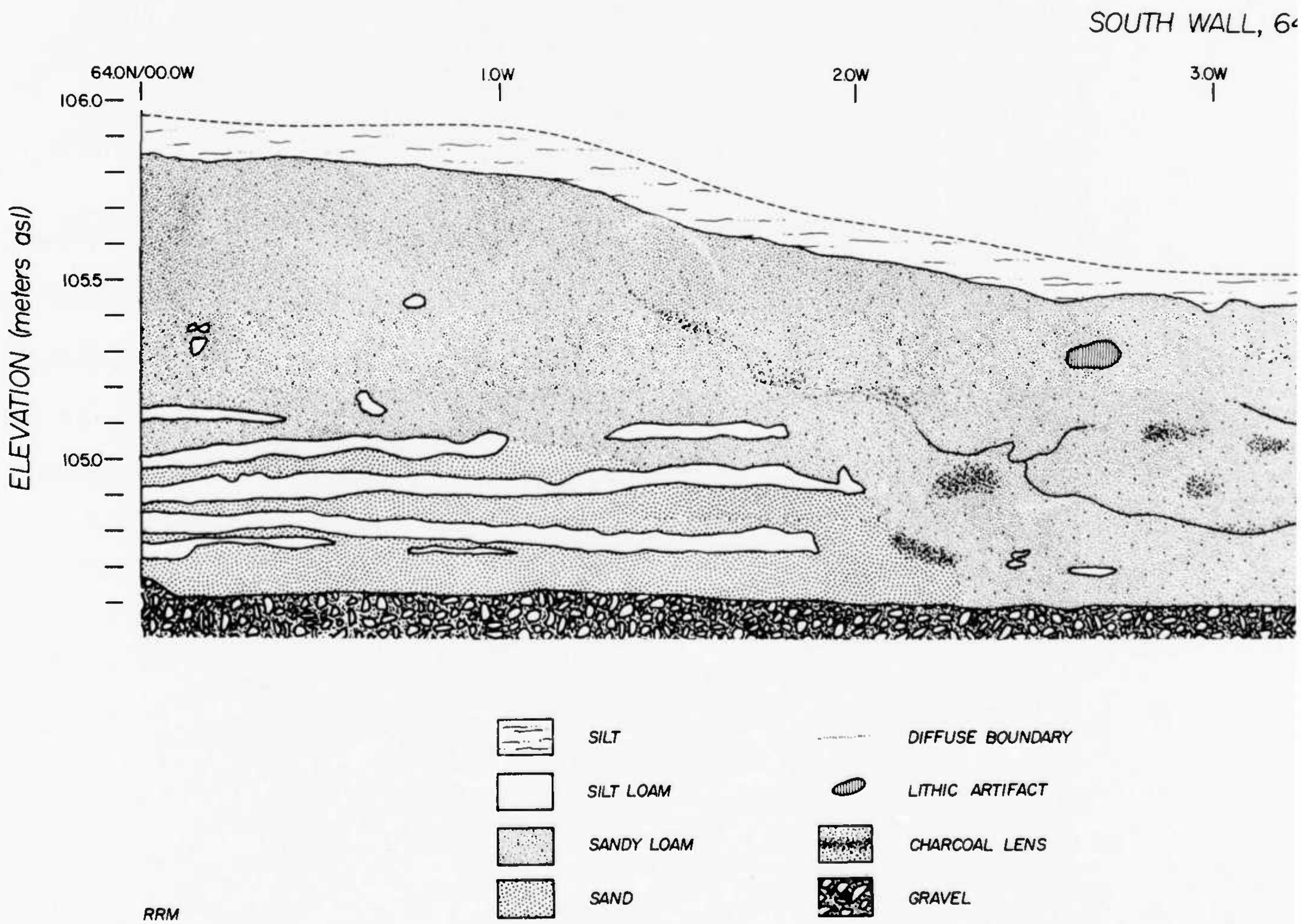
2



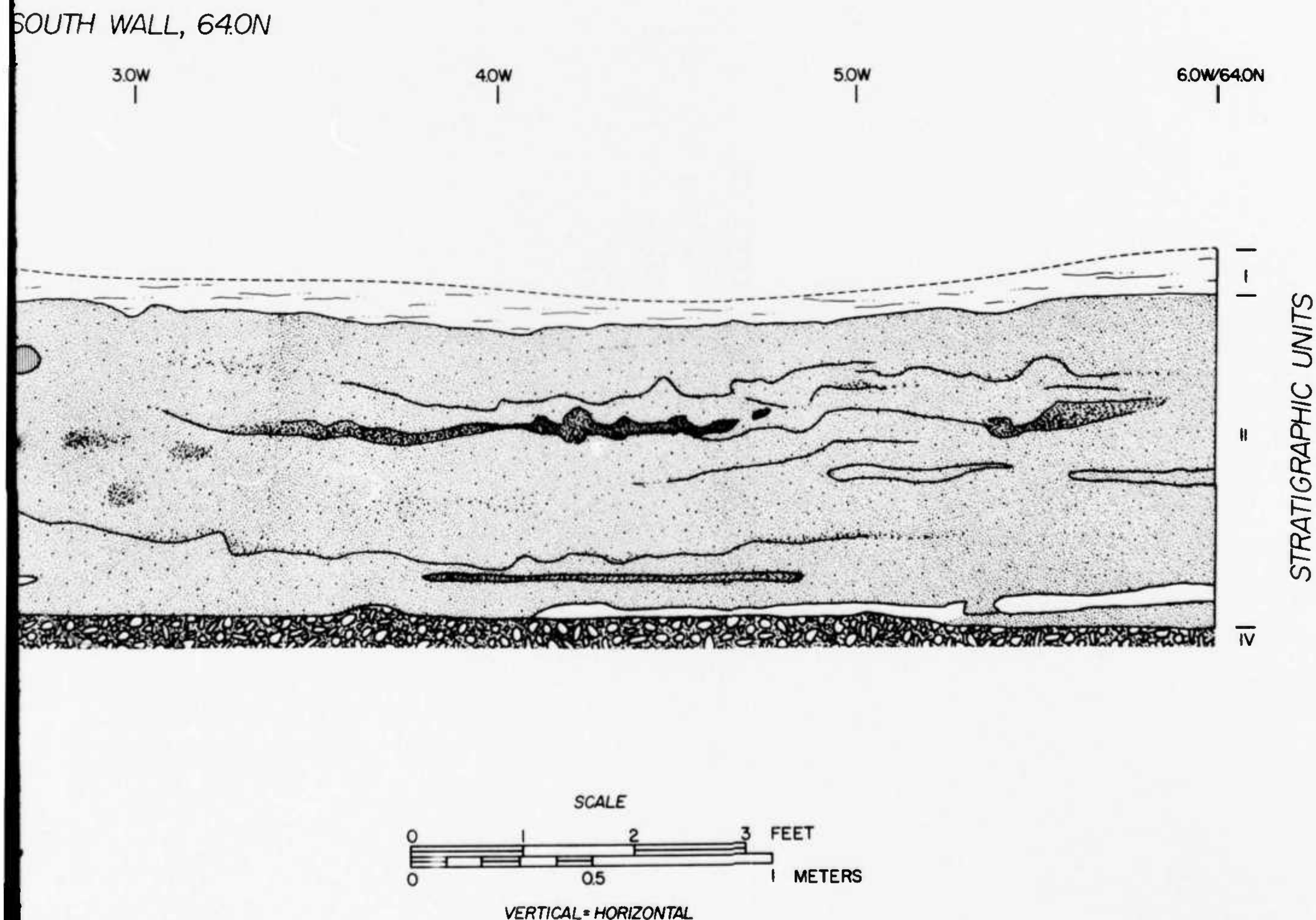
Profile Diagram of the So
Through Depression 96 Sho
Gradually Sloping Walls



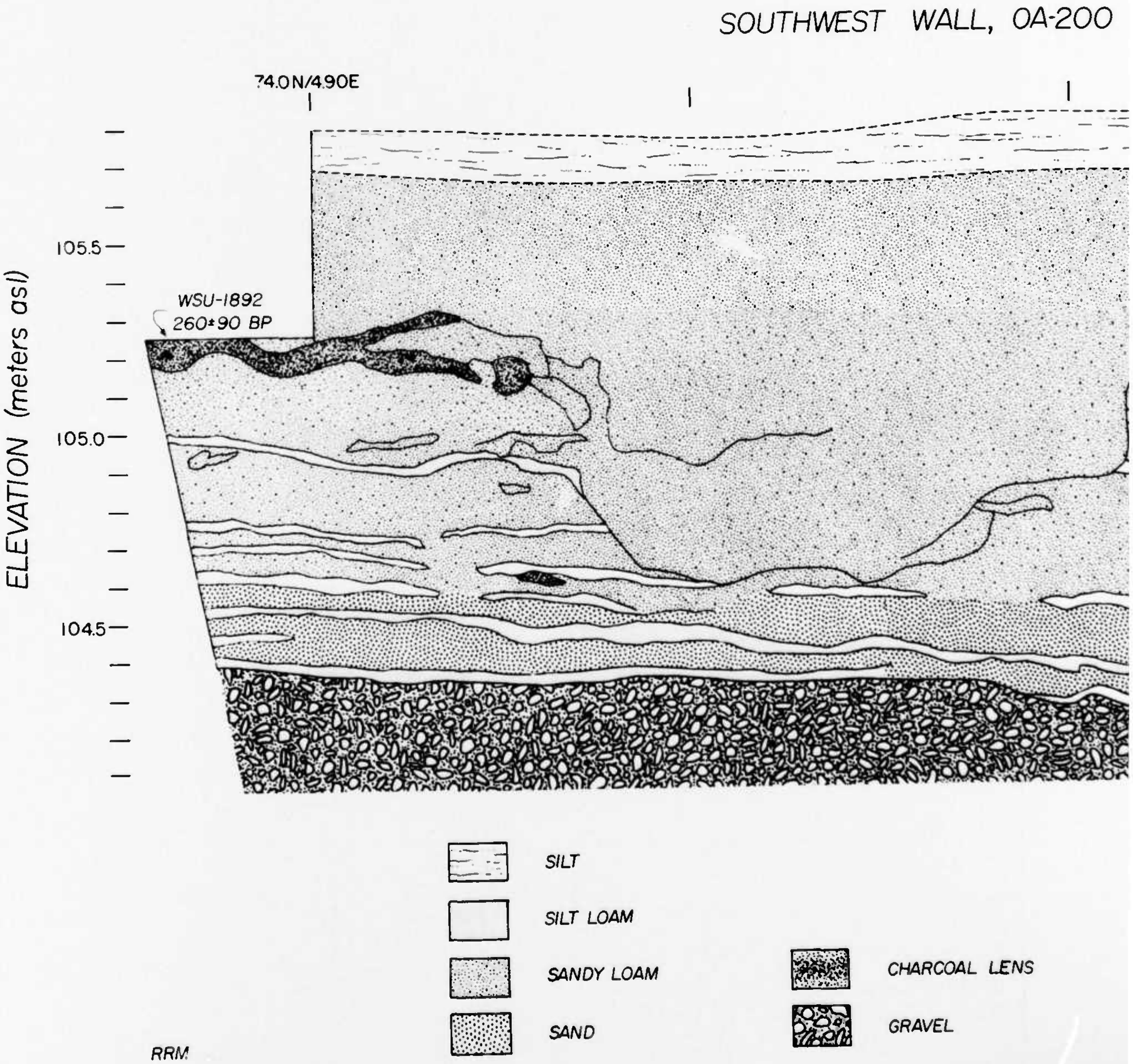
am of the South Wall of the Test Trench
ssion 96 Showing a Large Pit Feature with
ping Walls



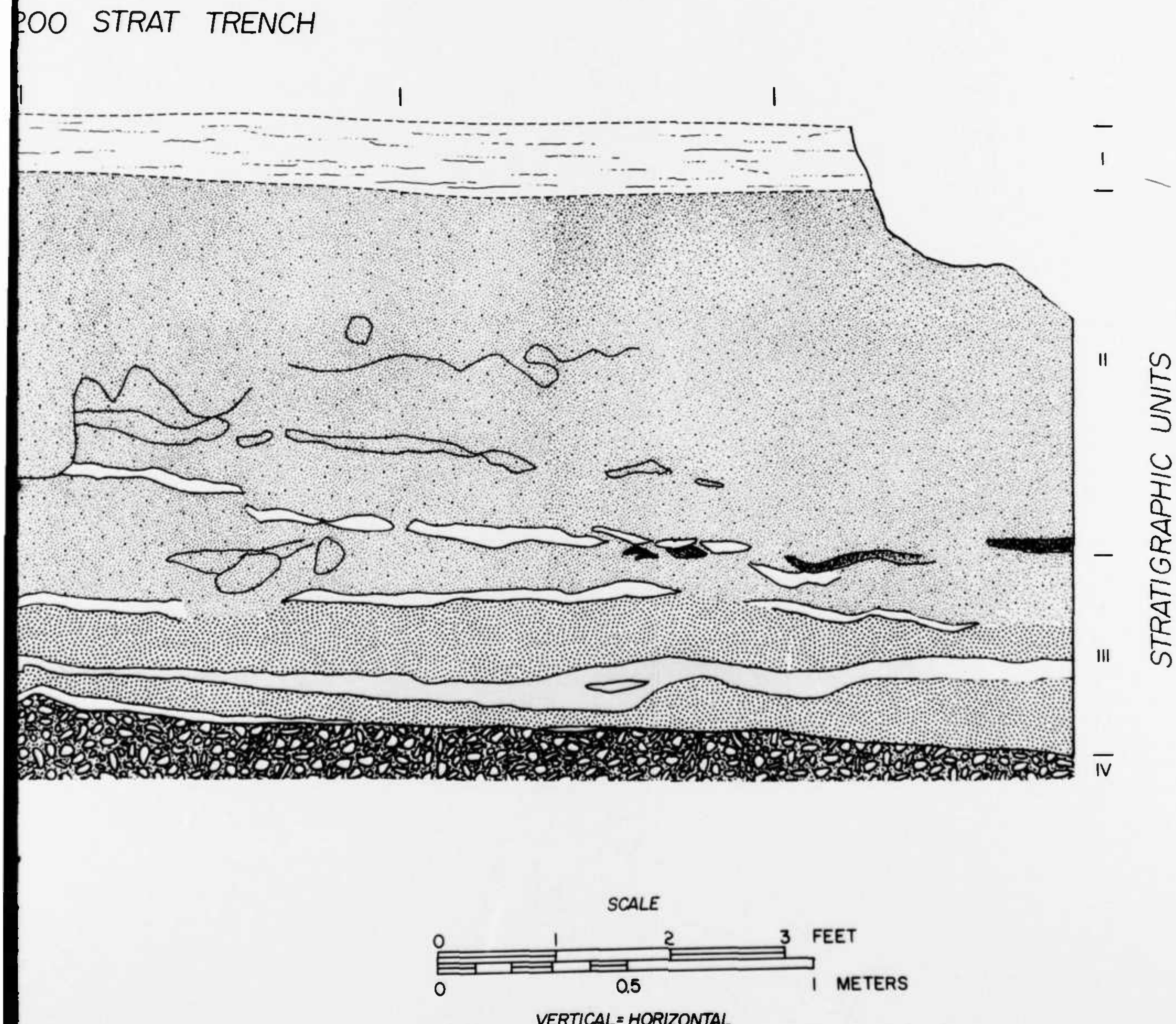
Profile Diagram of the South
Through Depression 76 Showin
Abrupt Walled Pit Feature



m of the South Wall of the Test Trench
sion 76 Showing One Side of a Steep,
Pit Feature



Profile Diagram of the S
Trench in Open Area 200
Abrupt Walls



he Southwest Wall of the Stratigraphic
200 Showing a Pit Feature with Steep,

2

APPENDIX D

Rare and/or Noncultural Taxa from the Faunal

Sample of the Miller Site 45FR5.

Taxon	Number of Elements	Excavation Unit
Ursus americanus	1	D-128
Bos sp.	1	Beach collection
Ovis sp.	1	Beach collection
Castor canadensis	1	OA-78: Area C, Level 31
Lutra canadensis	1	D-9
Mustela sp.	1	D-81
Microtus sp.	1	D-96
Heteromyidae	5	OA-78: Area F, Level 27
Reithrodontomys megalotis	13 152	D-65 D-67
Zapus princips	2	OA-78: Area I, Level 27
Peromyscus maniculatus	4	D-76
Mus musculus	1	D-9

APPENDIX E

Descriptive Measurements of Projectile Points from the Miller Site, 45FR5, by Excavation Units.

Appendix E lists the projectile points by excavation unit and provides descriptive measurements (Thoms 1977 for the method and rationale of these measurements). In addition to these descriptive measurements, the completeness of the point was assessed using criteria defined by Thoms (n.d.) for Washington State University's Libby Archaeological Project. Seven categories of completeness are defined and used. These categories are:

(1) COM - complete (or almost so, as to not affect measurements)
(2) DEM - distal end (or tip) missing
(3) LEM - lateral edge (or part) missing
(4) BBM - barb (or part) missing
(5) BEM - basal edge (or part) missing
(6) TGO - tang (or haft element) only
(7) MLB - multiple breaks.

Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Depression 9													
2401	S117/W148	7	--	12.02	4.03	12.02	--	--	--	--	--	--	BEM
7099	S118/W144	7	18.15	13.50	3.25	13.50	3.90	3.20	2.60	2.80	4.35	0.30	COM
7115	S118/W149	7	--	14.45	3.90	14.45	4.25	7.25	5.80	5.90	--	--	DEM
7438	S117/W148	9	--	--	3.02	--	--	--	5.50	--	--	--	MLB
Depression 30													
5419	S61/W111.5	4	22.70	10.90	2.02	10.90	3.02	~7.02	4.04	3.03	18.8	0.30	COM
5511	S60/W111.5	5	20.00	10.05	3.03	10.05	5.50	5.01	5.00	4.09	14.90	0.50	COM
5512	S60/W111	5	--	--	3.02	--	4.04	6.60	6.01	3.80	--	--	DEM
6787	S60/W111	5	--	--	3.02	--	4.04	6.60	6.01	3.80	--	--	MLB
5769	S62/W111	7	23.08	~12.07	--	~12.07	--	--	--	--	--	--	BEM
Depression 49													
472	S17/W47	6	--	--	3.30	--	--	--	--	--	--	--	MLB
5[illegible]0	S17/W47	8	--	--	2.00	--	--	--	--	--	--	--	MLB
Depression 59													
2230	N5/W43	7	--	--	3.80	--	--	--	--	--	--	--	MLB
Depression 61													
	N21/W48	5	--	20.40	5.65	20.40	6.65	16.60	12.80	6.70	--	--	DEM
Depression 65													
34	S5/W8	9	--	--	4.33	--	--	--	--	--	--	--	MLB

Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thickness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Completeness
Depression 67													
1674	Grid 3	7	21.65	9.90	2.60	9.90	4.10	3.10	3.10	1.50	17.35	0.30	COM
613	Grid 2 SE TT2	10	--	10.85	3.10	10.85	5.55	5.35	3.35	2.60	--	--	OEM
614	Grid 1 NE TT2	10	27.85	11.30	3.30	11.30	4.70	5.70	4.20	2.40	22.35	0.50	COM
628	Grid 2 SW	11	--	8.30	3.60	8.30	--	--	--	--	--	--	BEM
Depression 76													
161	N66/W06	2	16.01	16.60	2.70	16.60	3.80	5.00	4.04	3.80	16.01	0.20	COM
976	N66.14/W1.50	2	16.60	8.03	4.03	8.03	5.50	7.02	5.01	4.04	12.02	0.30	COM
1069	N62.00/W6.00	2	--	15.00	4.04	15.00	--	--	3.03	3.80	18.03	0.50	BEM
10	N67.63/W1.42	3	35.00	17.01	5.50	17.01	8.02	13.02	11.01	5.00	27.01	2.30	COM
612	N64.00/W0.00	3	23.03	10.00	3.80	10.00	5.00	4.04	4.90	4.04	19.03	0.50	COM
1945	N67.50/E0.50	3	--	--	--	--	10.00	18.03	--	--	--	--	DEM
2215	N67.50/E0.50	3	19.00	13.02	3.80	13.02	5.00	5.50	5.01	3.30	14.90	0.40	BBM
2171	N67.50/W0.00	4	--	16.60	4.03	16.60	--	--	--	--	--	--	DEM
1267	N64/W2	5	~18.05	13.00	4.40	~13.00	--	--	--	--	5.85	--	BEM
1123	N65.95/W3.73	8	--	19.01	6.75	15.54	--	--	--	--	--	--	DEM
1619	N64.50/W4.00	8	20.00	9.04	3.90	9.04	5.01	7.70	5.00	3.03	9.90	0.50	COM
22	N66/W2.00	--	15.00	11.60	4.04	11.60	6.01	5.50	5.00	4.90	12.01	0.20	COM
Depression 96													
5502	S54.00/E62.00	1	22.70	14.04	3.80	14.04	4.04	4.90	4.90	5.50	22.02	0.50	COM
7970	S54/E62	1	--	--	2.92	--	--	--	--	--	--	--	MLB

Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Depression 96 (Cont.)													
6006	S53.00/E61.00	4	--	13.02	3.80	13.02	--	--	--	--	--	--	BEM
6015	S53.00/E60.00	4	18.02	9.90	3.80	9.90	6.01	8.80	6.01	4.04	13.02	0.30	COM
5067	S60/E64	5	21.25	11.45	3.50	11.45	6.00	6.00	4.45	2.40	15.55	0.40	COM
6065	S55.72/E62.23	5	18.80	9.04	3.03	9.04	6.01	6.60	5.50	2.70	13.02	0.30	COM
5209	S60.82/E64.55	6	20.00	10.50	3.03	10.50	5.50	5.00	3.80	5.00	15.50	0.20	COM
6165	S56.00/E61.30	6	18.02	9.90	3.80	9.90	6.01	8.80	6.01	4.04	13.02	0.30	COM
6166	S56.00/E61.30	6	--	--	--	--	--	--	--	3.80	--	--	MLB
6415	S56.00/E61.00	7	--	--	2.20	--	6.60	--	--	3.30	--	--	DEM
6416	S56.00/E61.00	7	--	13.80	3.80	13.80	--	--	--	--	--	--	BEM
8495	S54.00/E60.00	9	--	--	1.85	--	--	--	--	--	--	--	MLB
504	--	--	21.60	11.60	3.80	11.60	6.01	6.60	5.00	3.03	17.02	0.40	COM
1537	S59.14/E62.36	--	--	12.01	3.80	12.01	--	--	--	--	--	--	BEM
2603	S58.41/E65.97	--	--	8.23	2.89	8.23	2.90	4.00	3.20	2.29	--	--	DEM
2886	S56.19/E64.75	--	--	8.02	3.02	8.02	--	--	--	--	--	--	BEM
3152	S56.63/E66.49	--	--	8.80	3.30	8.80	--	--	--	--	--	--	BEM
5015	S62.00/E66.00	--	22.02	9.04	2.70	9.04	4.03	6.01	4.03	3.03	19.03	0.20	DEM
5072	S55.80/E60.30	--	14.04	13.03	3.03	13.03	4.04	5.00	4.03	4.04	12.01	0.20	COM
5525	S52.00/E62.00	--	--	10.00	3.03	10.00	--	--	--	--	--	--	BEM

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Catalog Number	Provenience Unit	Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Depression 96 (Cont.)													
6179	S54.70/E63.45	--	17.07	7.07	3.03	7.07	4.04	4.03	3.80	3.90	13.80	0.10	COM
6471	S55.34/E62.41	--	20.00	14.04	3.02	14.04	3.80	4.90	4.40	4.40	21.00	0.30	BBM
Depression 114													
811	S22/W84	2	--	12.01	4.90	12.01	--	--	--	--	--	--	BEM
946	S22/W84	5	20.25	8.70	3.10	8.70	4.60	6.00	3.40	2.60	15.40	0.50	COM
Depression 117													
27	S44/E70	1	18.90	12.10	2.10	12.10	5.90	4.00	3.50	4.75	3.35	0.30	BEM
	S44-45/E69.54-70	1	--	9.09	2.02	--	--	--	--	--	--	--	BEM
	S44-46/E68-70	2	23.02	12.70	2.02	12.70	6.60	8.80	9.02	4.04	17.01	0.50	COM
	S44-46/E68-70	2	--	--	3.02	--	--	--	--	--	--	--	BEM
	S44-46/E70-72	2	--	--	2.70	--	--	--	4.03	--	13.03	--	BEM
1492	S44.10/E68.38	4	--	12.00	1.90	12.00	4.20	4.10	3.60	3.35	--	--	OEM
2163	S44.33/E72.85	4	--	14.90	2.70	14.90	--	--	6.01	--	--	--	MLB
566	S44/E70	5	--	--	3.03	--	--	--	--	--	15.50	--	BEM
578	S44/E70	5	18.03	9.04	2.02	9.04	8.70	13.80	4.09	2.02	11.01	0.30	COM
1073	S45.05/E70.75	5	22.80	11.50	2.55	10.55	5.00	11.50	8.05	1.50	17.90	0.50	COM
2334	S44.47/E73.46	5	21.01	9.40	3.80	9.40	4.04	4.90	4.50	2.20	17.10	0.30	BEM
2469	S44/E68	6	22.05	13.36	3.85	13.36	3.30	2.50	2.50	3.74	18.92	0.30	COM
	S44/E68	6	--	--	2.02	--	--	--	6.01	--	--	--	MLB
1624	S45.50/E71.50	7	--	9.90	3.02	9.90	6.60	9.04	5.50	2.70	--	--	DEM

Catalog Number	Provenience Unit	Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Depression 117 (Cont.)													
3257	S45.00/E68.25	7	20.00	8.30	3.30	8.30	6.60	4.40	4.04	4.40	14.04	0.20	BBM
4062	S44/E68	--	~18.50	12.32	3.47	~12.32	--	--	--	--	16.10	--	BEM
Depression 119													
5051	S36.29/E76.92	2	31.60	18.01	5.00	18.01	6.60	8.03	8.02	6.60	27.01	0.90	COM
5057	S36.00/E76.00	2	20.00	14.04	3.80	14.04	7.70	6.01	5.00	7.02	18.80	0.70	COM
5066	S34.00/E76.00	2	21.01	10.50	2.70	10.50	5.00	6.01	5.50	3.80	17.02	0.30	COM
755	S33.83/E81.77	3	14.04	7.01	2.02	7.01	5.00	6.01	4.90	3.02	9.40	0.10	COM
1396	S33.04/E82.28	3	18.80	12.70	4.40	12.70	5.00	7.01	6.10	3.80	13.30	0.50	COM
5151	S35.48/E76.08	3	14.04	11.60	2.70	11.60	5.00	4.90	4.04	3.03	12.01	0.10	COM
	S32/E80	4	--	--	4.90	--	--	--	--	--	--	--	MLB
	S32/E78 Feat.2	7	23.03	15.00	2.01	15.00	6.01	4.09	5.01	6.01	21.01	0.40	COM
Depression 128													
3385	S60/E43.5	8	--	--	--	--	--	--	--	--	--	--	MLB
3397	S60/E43.5	8	--	--	--	--	--	--	--	--	--	--	MLB
3398	S60/E43.5	8	--	--	--	--	--	--	--	--	--	--	MLB
5305	S60/E43.5	8	32.80	8.45	2.70	8.45	4.50	4.35	3.40	2.70	27.90	0.80	COM
5326	S60/E43.5	8	--	--	--	--	--	--	--	--	--	--	MLB
5327	S60/E43.5	8	22.75	14.90	2.80	14.90	6.25	5.95	4.85	4.80	17.15	0.50	COM
Open Area 78-A													
71	S17/W91	26	17.55	11.75	2.95	11.75	--	--	--	--	15.15	--	BEM

Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Open Area 79-H													
1671	S22/W87	30	22.05	9.90	2.55	9.90	5.40	6.60	4.45	3.10	17.20	0.40	COM
Open Area 79-I													
1747	S21/W89	29	--	9.05	1.90	9.05	--	--	--	--	16.00	--	BEM
1887	S23/W90	30	31.10	16.50	4.30	16.50	--	--	--	--	31.10	1.70	COM
Open Area 79-O													
566	--	3	33.03	12.02	4.04	12.02	6.60	6.01	5.00	6.01	27.70	1.90	DEM
289	S25/W80	5	--	--	3.03	--	--	--	--	--	--	--	MLB
163	S25/W80	6	--	--	4.04	--	--	--	--	--	--	--	MLB
297	S25/W80	7	--	8.03	3.02	--	--	--	--	--	--	--	BEM
327	S25/W80	9	--	--	3.80	--	--	--	--	--	--	--	MLB
Open Area 200													
10	N72.69/E5.11	1	--	9.90	3.03	9.90	5.50	8.80	4.90	3.90	--	--	DEM
13	N72.00/E4.00	1	23.03	10.00	3.03	10.00	5.00	6.01	4.04	4.04	18.02	0.50	COM
44	N72.00/E4.00	2	26.01	8.02	3.8	8.02	5.50	3.90	3.03	2.01	21.01	0.40	COM
79	N73.87/E4.36	--	29.03	13.03	3.80	13.03	5.50	6.60	6.70	5.00	24.90	0.80	COM
125	--	--	19.04	11.01	3.03	11.01	4.03	4.04	4.03	4.03	15.00	0.30	COM
135	--	--	--	--	--	--	4.04	6.01	3.04	4.04	--	--	DEM
728	--	--	19.09	11.01	2.70	11.01	4.09	4.04	4.03	3.09	16.60	0.20	COM

Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thick-ness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Complete-ness
Open Area 78-G													
384	S25/W86	28	--	12.02	3.8	12.02	--	--	4.04	3.8	21.01	0.50	BEM
Open Area 78-H													
223	S22/W85	25	25.50	12.70	2.45	12.70	4.25	4.75	3.70	3.35	20.50	0.40	COM
374	S22/W86	26	40.65	9.00	3.80	9.00	4.10	5.80	3.45	3.00	36.30	1.10	COM
1080	S21/W86.5	28	26.85	16.20	2.45	16.20	7.05	6.30	4.90	5.65	19.50	0.60	COM
Open Area 78-I													
543	S23/W88	26	40.35	19.00	5.85	19.00	7.25	8.15	7.85	5.60	34.10	3.40	COM
749	S23/W88	27	18.30	8.00	1.40	8.00	3.15	3.65	2.70	2.10	4.80	0.10	COM
Open Area 79-C													
750	S22/W91	34	--	8.03	3.02	--	--	--	--	--	--	--	BEM
Open Area 79-D													
2011	S26/W91	30	--	--	2.40	--	--	--	--	--	--	--	MLB
2012	S26/W91	30	--	--	6.20	--	--	9.60	8.15	--	--	--	MLB
2226	S24/W91	36	--	--	1.90	--	--	--	--	--	--	--	MLB
2286	S25/W91	36	--	--	2.10	--	--	--	--	--	--	--	MLB
Open Area 79-F													
2075	S26/W91	29	--	13.10	2.75	13.10	4.40	5.10	4.65	2.25	--	--	DEM
2611	S25/W90	35	--	18.80	6.60	--	--	--	--	--	--	--	BEM
Open Area 79-G													
1050	S26/W87	33	--	10.00	3.03	10.00	5.00	5.01	4.03	3.02	--	--	DEM

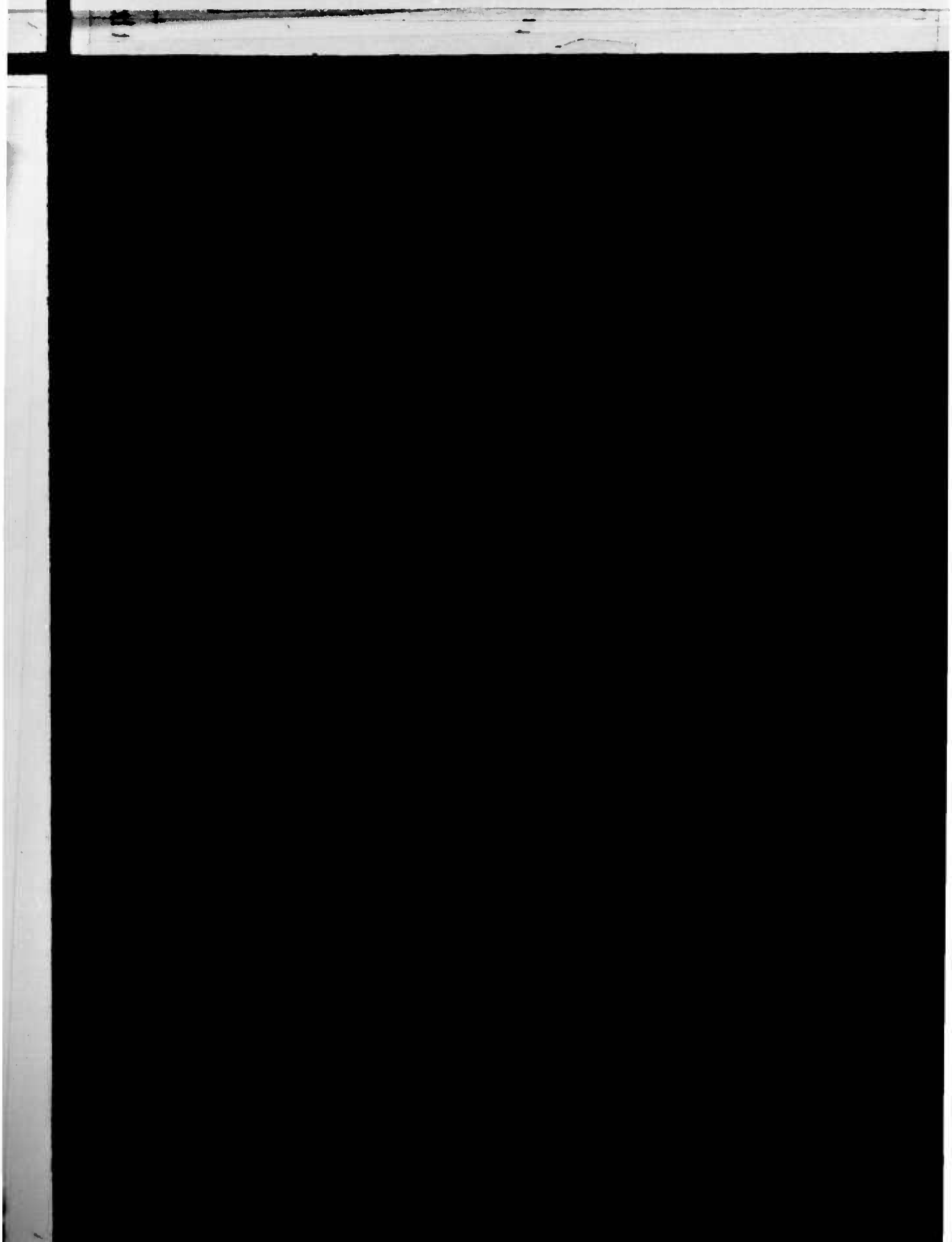
Catalog Number	Provenience Unit	Provenience Level	Max. Length	Max. Width	Max. Thickness	Shoulder Width	Base Length	Base Width	Min. Neck Width	Notch Width	Blade Length	Weight	Completeness
Open Area 78-B													
6	S18/W91	26	29.90	9.30	3.50	9.30	4.85	6.90	4.90	3.50	24.50	0.60	COM
37	S18/W91	26	--	--	1.45	--	--	--	--	--	--	--	MLB
1019	S20/W91	29	32.05	12.20	5.65	12.20	4.95	4.90	2.25	6.60	27.10	0.50	COM
Open Area 78-C													
171	S22/W91	26	18.60	11.90	3.85	11.90	5.45	5.00	3.25	4.35	3.35	0.40	COM
242	S23/W91	27	19.05	14.60	2.25	14.60	5.75	4.05	3.70	5.40	13.60	0.30	COM
372	S21/W91	27	18.70	13.50	2.40	13.50	4.05	3.45	3.00	5.60	14.75	0.30	COM
Open Area 78-E													
215	S27/W91	27	--	--	3.65	--	--	--	--	--	--	--	MLB
229	--	27	30.50	16.40	7.10	--	--	--	--	--	30.50	2.60	COM
Open Area 78-F													
269	S24/W88	26	--	--	2.90	--	5.15	5.15	4.10	3.50	--	--	MLB
611	S26/W89	26	--	10.75	2.45	10.75	5.80	4.50	3.25	3.40	--	--	DEM
439	N25/W90	27	27.60	11.50	4.00	11.50	5.15	5.20	3.50	2.40	22.60	0.90	COM
440	S25/W90	27	--	7.55	3.45	7.55	3.85	4.70	3.85	1.10	--	--	DEM
1261	S26/W89	27	--	--	3.25	--	--	--	--	4.80	--	--	MLB
1388	S25/W89	28	18.55	9.00	2.15	9.00	3.95	4.50	4.15	3.40	15.45	0.20	COM
411	S25/W88	--	25.45	9.90	2.50	9.90	5.40	4.10	2.75	2.30	20.00	0.30	COM
1492	S26/W88	--	19.70	8.70	3.50	8.70	6.55	6.00	4.75	4.40	12.90	0.30	COM

DATE

ILME

hwes he Southwest Wall of the Stratigraphic
wing 200 Showing a Pit Feature with Steep,

2



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Catalog Number	Provenience Unit
Depression 117 (Cont.)	
3257	S45.00/E68.25
4062	S44/E68
Depression 119	
5051	S36.29/E76.92
5057	S36.00/E76.00
5066	S34.00/E76.00
755	S33.83/E81.77
1396	S33.04/E82.28
5151	S35.48/E76.08
	S32/E80
	S32/E78 Feat.2
Depression 128	
3385	S60/E43.5
3397	S60/E43.5
3398	S60/E43.5
5305	S60/E43.5
5326	S60/E43.5
5327	S60/E43.5
Open Area 78-A	
71	S17/W91

Catalog Number	Proven[ience] Unit
Open Area 79-H	
1671	S22/W87
Open Area 79-I	
1747	S21/W89
1887	S23/W90
Open Area 79-O	
566	--
289	S25/W80
163	S25/W80
297	S25/W80
327	S25/W80
Open Area 200	
10	N72.69/E5.1[illegible]
13	N72.00/E4.0[illegible]
44	N72.00/E4.0[illegible]
79	N73.87/E4.3[illegible]
125	--
135	--
728	--

Catalog Number	Prove[nience] Unit
Open Area 78-G	
384	S25/W86
Open Area 78-H	
223	S22/W85
374	S22/W86
1080	S21/W86.5
Open Area 78-I	
543	S23/W88
749	S23/W88
Open Area 79-C	
750	S22/W91
Open Area 79-D	
2011	S26/W91
2012	S26/W91
2226	S24/W91
2286	S25/W91
Open Area 79-F	
2075	S26/W91
2611	S25/W90
Open Area 79-G	
1050	S26/W87

Catalog Number	Proven... Unit
Open Area 78-B	
6	S18/W91
37	S18/W91
1019	S20/W91
Open Area 78-C	
171	S22/W91
242	S23/W91
372	S21/W91
Open Area 78-E	
215	S27/W91
229	--
Open Area 78-F	
269	S24/W88
611	S26/W89
439	N25/W90
440	S25/W90
1261	S26/W89
1388	S25/W89
411	S25/W88
1492	S26/W88

DTI